A LOCOMOTIVE FOR BEGINNERS

By way of interlude, LBSC begins a brief description of a neat locomotive suited to enthusiasts and novices of limited means

A SHORT while ago I described how to build a simple steam locomotive especially suited to children's operation, and I offered to elaborate on it if prospective builders were sufficiently interested.

In addition to Postbag comment I have received some direct correspondence on the subject, so I carefully sorted out the various suggestions, and I have done my best to produce what might be called a de luxe version of *Pixie*. It would cost no more to build, is an ideal job for novices, and is a fairly close copy, as far as appearance goes, of a popular class of locomotive that did yeoman service on the Great Eastern Railway in days now long past.

I specified outside single-acting oscillating cylinders for *Pixie*, to reduce the job to the rock-bottom of simplicity, and strangely enough it was just this that was the controversial feature. I agree that no full-size locomotive ever had such appendages (I might add that no full-size locomotive ever had a spirit-fired water-tube boiler !) but to have put them inside would have needed a double-cranked driving axle, and a much more complicated arrangement of port blocks, pipes and reversing gear.

Objections were raised to the unsprung single driving wheels; but if these had been sprung, it would have cattled up the steam distribution. As the centre line of the axle and trunnion must pass exactly between the ports, it naturally follows that any up-and-down movement of the axle neutralises the setting, and any variation in the level of the track would cause the engine to run in jerks—if it didn't stop her altogether. Coupled wheels could not be used with cranks set exactly opposite, as the coupling-rods would tend to cross on the dead centres, and lock the wheels.

Anyway, to cut a long story short, in the design I am now presenting I have eliminated practically every objection raised. The outside cylinders are replaced by a single inside slide-valve cylinder with loose-eccentric reversing. This is quite easy to make and erect, and only needs a single-cranked axle.

Fully-sprung coupled wheels can be used, with the crankpins at the usual right angles; and with the smaller wheels and the extra adhesion the locomotive would be much more powerful than *Pixie*. The same type of boiler can be used, the only difference being that it is a little longer, but it can be worked at a higher pressure.

Older readers may recollect the LMS 4F class 0-6-0 that I built for the six-year-old son of the chicken farmer whom we stayed with for a few weeks during the flying-bomb raids of 1944. This engine had a similar arrangement of single inside cylinder and spirit-fired boiler, and she had no great difficulty in pulling my weight on a flat car. It would not entail much more work to finish the job, in a manner of speaking, and provide *Rose* with a coal-fired boiler; if anyone wishes to do so, I will provide the gen with pleasure.

As machining, fitting, and erecting jobs are similar to those described for many other locomotives appearing in these notes, I need not go into full detail with a lot of wearying repetition. The following "condensed" instructions plus the dimensioned drawings should enable anybody with the usual amount of perspicacity and patience to turn out a good job.

FRAME ASSEMBLY

The arrangement of frames is the same as on the full-size GER mixed-traffic locomotives, except that the leading wheels have the outside bearings only. Both inside and outside frames are cut from 16-gauge sheet steel, the soft blue kind being most suitable. Mark out one of each kind, temporarily rivet each to a piece of similar overall dimensions, and saw and file to outline.

Points to note when marking out are correct location of cylinder and motion bracket. The centre line of motion is obtained by drawing a diagonal line from a point exactly in the middle of the driving axle-box opening to the centre of the front end of the frame where the buffer beam will be attached. Set out the locations from this line, drilling the screwholes as shown.

The hornblocks are cut from the same kind of metal as the frames, and no castings are required. The leading horns are straight-sided and flat, and attached to the inner sides of the outside frames by $\frac{1}{16}$ in iron rivets. The driving and trailing horns are bent at right angles at the bottom (see side view) to form lugs to which the hornstays are attached.

As the jaws of the hornblocks are the same width and height as the openings in the frame, they can be lined up correctly by putting a piece of bar, $\frac{5}{8}$ in. wide, in the opening, setting the hornblocks over it, and holding each in place with a toolmaker's cramp while riveting up.

As the leading axle has no bearing in the inside frame, all that is required is a plain slot to clear it.

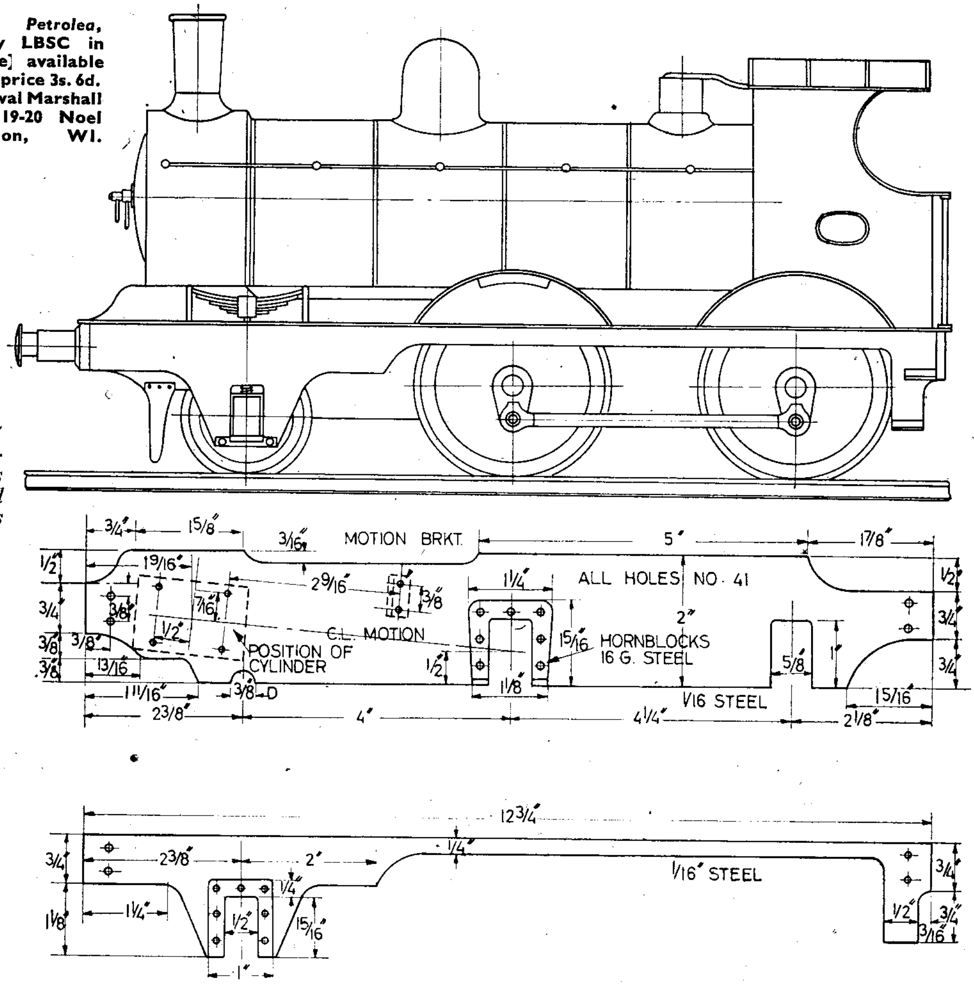
The buffer and drag beams are $4\frac{1}{2}$ in. lengths of $\frac{3}{4}$ in. $\times$ $\frac{1}{8}$ in. steel or brass angle. Pieces of $\frac{5}{8}$ in. $\times$ $\frac{1}{8}$ in. brass angle are riveted to the inner edges of the frame slots, and also flush with the cut-away ends, as shown in plan. The inner frames are driven into the slots and secured by screws as shown, then the outer frames are screwed to the end angles. They take the place of the running-board valances on a single-framed locomotive. No separate staying is needed between the inside and outside frames, as they are attached to the running boards which keep them in alignment.

When erecting, level up the inner frames and beams on the lathe bed, or something equally flat and true, before drilling and tapping the screwholes in the angles. If you get that part of the business right, as fully described in previous notes, the outside frames will fit in correctly without any special lining-up.

AXLE BOXES

The leading axle boxes can be made from $\frac{5}{8}$ in. square rod, bronze or gunmetal for preference. Clamp a length sufficient for two boxes under the slide-rest toolholder, and mill the rebate with an end-mill or slot-drill in the three-jaw. The rebated part should fit easily between the horn-

Blueprints of *Petrolea*, referred to by LBSC in this article, are available in seven sheets, price 3s. 6d. each, from Percival Marshall Plans Service, 19-20 Noel Street, London, W1.



General arrangement with details of the inside and the outside frames

block jaws in the outside frame, but should not be slack. Saw the piece in half and true up the sawn faces in the four-jaw. The hole for the axle journal must be dead square with the back; if using a drilling machine, set the axle box, back upwards, in a machine vice so that the back is level with the tops of the jaws, and be careful to avoid drilling clean through the face. The front edges are bevelled off with a file for appearance' sake. Don't forget to drill the oil hole.

Springing is simple. A piece of 3/32 in. silver steel $\frac{7}{8}$ in. long is screwed into the top of each box. A bracket bent up from $\frac{5}{16}$ in. × $\frac{1}{16}$ in. strip steel is riveted to the inside of the frame directly above the hornblock, and the pin passes through a hole drilled in it. The spring is wound up from 20-gauge tinned steel wire. The hornstay which prevents the box falling out when the engine is lifted is a strip of $\frac{1}{8}$ in. × $\frac{1}{16}$ in. steel with the centre part reduced to $\frac{1}{16}$ in., as shown, and it is attached to the outside of the frame by a $\frac{1}{16}$ in. or 10 BA screw at each end.

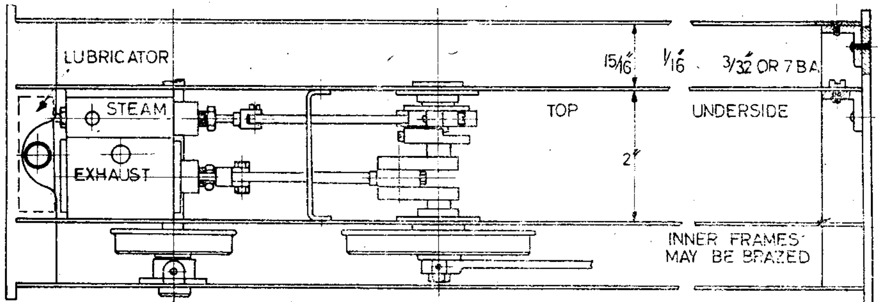
The driving and trailing axle boxes are made from $\frac{5}{16}$ in. × $\frac{3}{4}$ in. bronze or gunmetal rod, a piece approximately $3\frac{1}{2}$ in. long being required. The rebates on each side are milled as previously described, to fit nicely in the horns, and the four boxes can then be parted off in the four-jaw chuck, or sawn off to full length and the ends truly faced off in the chuck to correct length.

Fit each box to one of the openings in the frame, and mark the right-hand 1 and 2, and the left-hand 3 and 4. Make a centre pop exactly in the middle of 1 and 2, drill it No 30 either in the drilling-machine or lathe, as the hole must be dead square through the box, and use the drilled boxes as jigs to drill the boxes on the opposite side, taking great care to clamp the boxes together exactly in line when drilling the second one.

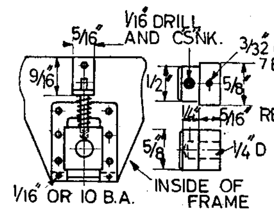
Put the boxes temporarily in the frame, and test each pair with a piece of $\frac{1}{8}$ in. silver steel put through the holes. If this lies squarely across the frame, open out the holes with 23/64 in. drill. Next fit the hornstays to the lugs at the bottom of the hornblocks; these are merely $1\frac{1}{8}$ in. lengths of $\frac{5}{16}$ in. × $\frac{1}{16}$ in. steel drilled as shown and attached by 3/32 in. or 7 BA screws.

Put each box in its opening, flange outside, jam it tightly against the hornstay, put a No 41 drill through the hole in the stay and make a countersink on the bottom of the axle box. Drill this No 48 and tap 3/32 in. of 7 BA. Screw in a spring-pin made from 1 in. of 3/32 in. silver steel screwed at both ends as shown,

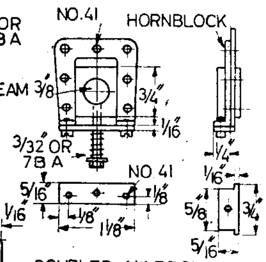
A LOCO FOR BEGINNERS



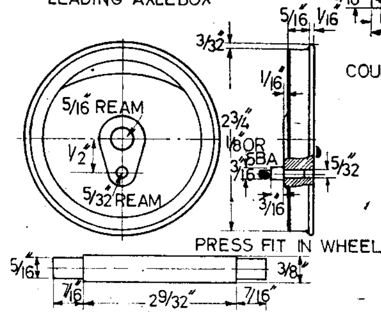
FRAME AND MOTION



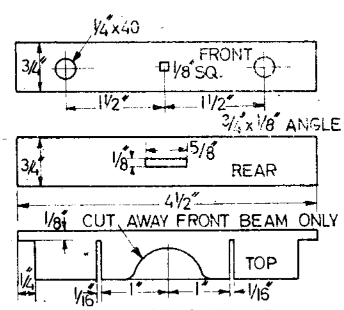
LEADING AXLEBOX



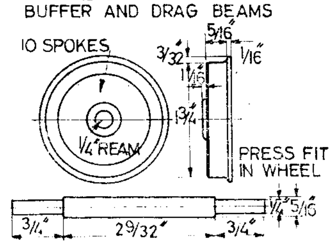
COUPLED AXLEBOX



COUPLED WHEELS AND TRAILING AXLE



BUFFER AND DRAG BEAMS



LEADING WHEELS AND AXLE

fit a 20-gauge tinned steel wire spring on it and secure it with a commercial nut and washer.

These springs cannot be properly adjusted until the engine is completely finished and in working order; the nuts are then adjusted so that the axle boxes are midway between the top of the opening and the hornstay. The engine should then stand level, with the beams the same height at each end from the rail heads. Meantime, to keep the boxes in running position when erecting cylinder and motion, put a little piece of $\frac{1}{8}$ in. square rod between axle box and hornstay, and tighten the nut sufficiently to keep it there. Finally put a $\frac{3}{8}$ in. parallel reamer through each pair of boxes while they are in place in the frames; this ensures correct alignment.

WHEELS AND AXLES

The leading wheels are $1\frac{3}{4}$ in. dia. on tread, with 3/32 in. depth of flange, and are turned as described recently for *Zoe*. The axle is made from a piece of $\frac{5}{16}$ in. round mild-steel rod $3\frac{1}{8}$ in. long. Chuck in the three-jaw, face the end, and turn a full $\frac{3}{4}$ in. to $\frac{1}{4}$ in. dia., which should be a press fit in the reamed hole in the wheel boss. Reverse in chuck and repeat the operation, leaving 2 9/32 in. between shoulders. Both wheels can then be pressed on to the axle, but need not be erected in frames until after the cylinder and motion have been made and installed in place.

The coupled wheels are $2\frac{3}{4}$ in. dia. on treads, with same depth of flange, and are also machined like those for *Zoe*, but to the dimensions shown in the drawing. Drill the crankpin holes by aid of the simple jig previously described, using a No 24 drill, and ream them 5/32 in. The crank pins can then be turned and fitted right away.

Chuck a piece of $\frac{3}{16}$ in. silver steel and turn $\frac{5}{16}$ in. length to a press fit in the reamed hole. Part off at a full $\frac{5}{16}$ in. from the shoulder, reverse in the chuck, turn $\frac{1}{8}$ in. of the end to $\frac{1}{8}$ in. dia. and screw $\frac{1}{8}$ in. or 5 BA. Put a brass nut on the thread to protect it from damage when pressing the pin into the wheel boss by aid of the bench vice.

Warning—pins press-fitted into cast-iron wheel bosses must not be *too* tight, or the bosses will split. The pins should just be tight enough to prevent their coming out or turning.

The trailing axle is straight, and is turned from a piece of $\frac{3}{8}$ in. round mild steel $3\frac{1}{4}$ in. long. If the three-jaw chuck is true within the usual limit, simply chuck the rod, face the end and turn $\frac{7}{16}$ in. length to a press fit in the wheel boss. Reverse in chuck and repeat operation, leaving 2 9/32 in. between shoulders. If the chuck is out of truth, the axle must be turned between centres, using a little larger steel.

The wheel seats must be true with the axle or the wheels will run like eccentrics. Press one wheel on the axle, put it through the trailing axle boxes, and then put the other wheel on, setting the crank pins at right angles as described for *Zoe*. All being well I will describe how to make the crank axle and fit the eccentric and wheels in the next instalment.

Meanwhile, if any reader has a yen to build this engine in $3\frac{1}{2}$ in. gauge, he can do so by increasing all the dimensions in the proportion of 5 to 7. It would be a great help if he obtained the blueprints of *Petrolea* from the Plans Service as this engine is of similar type to *Rose*, excepting that she has larger wheels. In the $3\frac{1}{2}$ in. gauge size a better turning movement would be obtained by using two cylinders of medium size, and the simple loose-eccentric valve gear could still be retained; anyway I will be glad to go into this later if there is any call for the information.

● *To be continued*

prised if there are no more single-cylinder beam engines at work. (Or does the writer mean an identical engine ?)

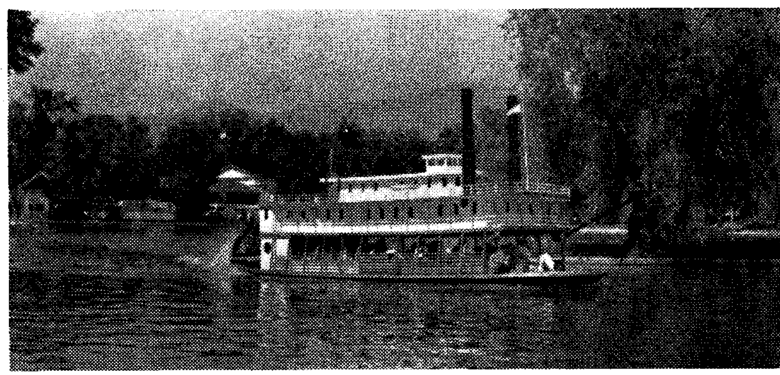
I can quite believe that it formerly had a hand gear, as this was often the case with single-cylinder engines used for winding or hauling. At no time did a lad or anyone else control the stroke—the crank did that.

Whoever took the photograph, took it at just the right time. The house and floors have been removed but the engine is still intact.

A careful study of the picture reveals several interesting points. (1) Unlike most beam engines but like most models it is mounted on a bed plate. (2) A very unusual feature is slide bars in place of parallel motion. The only other cases of similar guides that I know of were on some Cornish beam winding engines that had round slide bars; and those very large beam engines used on American paddle steamers. These seem to have had channel-section guides.

Note, also, how much thicker the beam is in the centre than at the ends, and also how large and slender the flywheel is. Then turn to page 32 [July 4]. Which of the two—Ben or Vulcan—has most right to be kept in a museum ?

Shipley, Yorks. — Frank D. Woodall.



Imitation of Mississippi steamboat at Liberty Park in Salt Lake City. It is powered by a petrol engine and takes 50 youngsters twice round the lake for 20 cents

TURNRICE PLOUGH

Sir,—Your contributor who found inspiration in the old turnrice plough [Postbag, July 18], which incidentally always walked off with the premier awards at the local ploughing matches back home, may be interested to know that the words of command shouted at the "hosses," were "Hup" for turning to port, and "Huther" for the starboard turn.

On the subject of diesels, damned and otherwise, this newer form of motive power has just started to replace the Schools class steamers, and the change has made the correspondence of local papers fairly sizzle. Recently one of your own readers described a steam engine as something "with its guts hanging out."

It may interest this reader to know that after several journeys up to town behind a diesel electric, the awful stench that pervades the whole train, to say nothing of passing through tunnels, has convinced me that the diesel engine's innards have been hanging out longer than any steam engine.

Re the veteran coach : Our Brighton friend [Postbag, July 25] should remember that it is in Kent where the first cherries are picked. Malleable wheels were common round my home long before the Kaiser's war. In fact, the only wooden wheeled wagon we ever saw was a Sentinel type steam wagon built by a Maidstone firm with the strange name of Jesse Ellis.

Chain cases never appeared until after that war, the first being on the Halfords, these a product of the well-known Dartford firm of refrigeration engineers. But the driver of the village farmer's wagon was quick to see the disadvantages of these "new fangled guards." "Why ya carn't see if the chains is too tight or too slack or if they wants agreasin'."

He was certainly right about the chain adjusters as well, because these were never part of the chain guard. How could they be? The adjuster pushed the axle back in its massive chassis slots which housed the axle bearings. As for that early example of steering column gear change—the array of rods, angle levers and locking devices must have rivalled the point system outside Victoria Station.

Sedlescombe, Sussex. — George W. Eves.

Sir,—Referring to a letter and photograph of a horse drawn plough Mr Ford's letter agrees with my recollection of these ploughs as used in SE Kent, but the photograph does not agree with my model of a Kent plough.

The chain and long link behind the axle should surely extend to a fitting at the base of the handles, and be adjustable.

Headington, Oxford. — G. Eastes.

ROSE . . . continued from page 272

material for glands and put gaskets of thin oiled brown paper or 1/64 in. Hallite between the cylinder covers and block, and between cylinder, steam chest and cover. The complete assembly should be exactly 2 in. wide to fit between the frames without spreading or distorting them.

If it is found that the cylinder won't go in easily reduce the overall width by removing the steam chest and taking a little off the contact face that goes next to the cover. There is plenty of latitude here, as I fitted a similar cylinder assembly to the frames of the LMS 4F mentioned in the previous instalment by taking a full $\frac{1}{16}$ in. off. This engine had 3/32 in. frames with $1\frac{15}{16}$ in. between them.

The complete assembly is located between the frames in the position indicated by the dotted lines in the frame drawing. The middle of the front cylinder cover should be approximately $\frac{5}{8}$ in. from the back of the leading buffer-beam. The front end of the cylinder should be $\frac{3}{8}$ in. below the top of the frames, and the slope or angle should be such that the centre line of motion should cut exactly across the middle of the crank axle when the axle boxes are in running position. This is easily checked by pulling out the piston rod as far as it will come and putting a straight close-fitting piece of tube over the end; this should pass centrally between the crank webs level with axle centre.

Adjust the cylinder to the position stated, then put a big cramp right over the outside of frames to hold it there. Put a No 41 drill through the screwholes in the frames, on each side, making countersinks on the cylinder block and steam-chest cover.

Remove the cylinder, drill the countersinks No 48 and tap 3/32 in. or 7 BA. Don't bother to put the cylinder back yet because it cannot be permanently erected until the guide bar, crosshead and connecting-rod are fitted—and that will be the next job.

● *To be continued*

ROSE

LBSC's second instalment for building a simple $2\frac{1}{2}$ in. gauge beginner's locomotive deals with the crank axle, eccentric and cylinder

Continued from 8 August 1957, pages 198 to 200

CORRESPONDENCE over many years has indicated that novices usually have difficulty in making a crank axle and getting it to run truly. Over 65 years ago I made a crank axle, using a big French nail for the axle; the webs were cut from a discarded brass clock plate, and the axle ran truly.

The method used was similar to that I am about to describe, except that I didn't turn wheel seats and crank pin ends—I had no lathe—and soldered the joints as I had no blow-lamp.

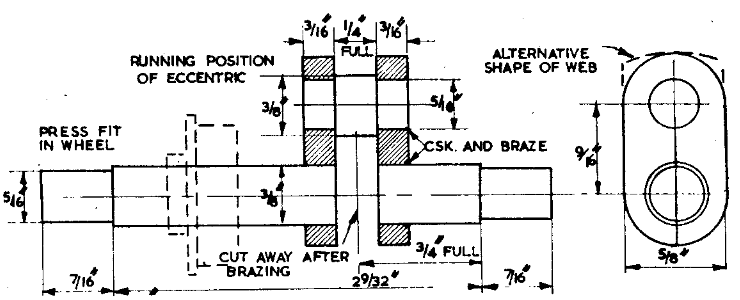
First turn a straight axle exactly as described in the previous instalment. Saw off two pieces of $\frac{3}{16}$ in. × $\frac{5}{8}$ in. mild steel, each $1\frac{1}{4}$ in. long. Set out the axle and crank pin centres on one of these, taking care to make the pop marks dead on the centre line, clamp them together, and drill a $\frac{5}{16}$ in. hole through each mark.

Open out one with a 23/64 in. drill, separate them, and open out the larger holes with the lead end of a $\frac{3}{8}$ in. parallel reamer until they are a very tight fit on the axle. Countersink one side of all the holes.

Chuck a bit of $\frac{3}{8}$ in. round mild steel, face off, turn $\frac{3}{16}$ in. length to a very tight fit in the $\frac{5}{16}$ in. hole, part off at $\frac{7}{16}$ in. from the shoulder, and turn down the other end to the same dimensions. Squeeze a web on each end, countersinks outward, then drive the axle through the larger holes until it projects $\frac{7}{16}$ in. plus 1/64 in. from the shoulder. This will automatically line up the webs.

Bend two pieces of 16-gauge soft brass wire into rings, put one at each side of the crank webs as close to them as possible, cover with wet flux (Boron compo mixed to a paste with water), place some more around the ends of the crank pin, put the assembly in the brazing pan on its side, and heat to bright red. As soon as the wire ring melts and disappears into the countersink, touch the end of the pin with a piece of the same kind of brass wire which will melt and fill up the countersink. Turn the axle over and repeat the operation on the other web.

Let it cool to black, quench out in cold water, then very carefully saw out the bit of axle between the webs. Finally, clean up the lot. It doesn't make any difference whether the ends are rounded off or left square—just please yourself. Simple job, isn't it ?



Above: The crank axle

ECCENTRIC AND STOP COLLAR

Chuck a short piece of 1 in. round mild steel (a stub or offcut of 1 in. shafting does fine), face the end, and turn down $\frac{1}{4}$ in. length to $\frac{7}{8}$ in. dia. Part off at $\frac{3}{16}$ in. from the shoulder. At $\frac{3}{16}$ in. from centre indicated by tool marks, make a centre pop, and chuck in the four-jaw with this running truly.

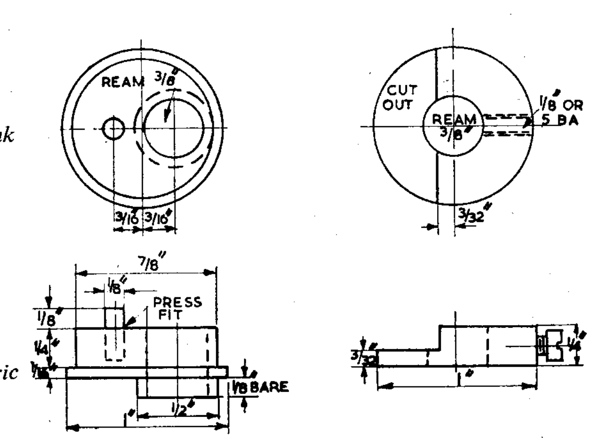
Open out with a centre drill, then drill through with 23/64 in. drill and ream $\frac{3}{8}$ in. Mount this on a stub mandrel (short piece of steel turned to a drive fit in the hole) with the flange outwards, chuck the mandrel in the three-jaw and turn down the flange for $\frac{1}{8}$ in. length to $\frac{1}{2}$ in. dia., then skim the end true. On the opposite side at $\frac{3}{16}$ in. from centre, drill a No 32 hole and squeeze a $\frac{1}{8}$ in. silver-steel pin in it, letting $\frac{1}{8}$ in. project. This eccentric should just slide on the crank axle without shake.

For the stop-collar, chuck the 1 in. rod again, face, centre, and drill to $\frac{3}{8}$ in. depth with a 23/64 in. drill. Part off at $\frac{1}{4}$ in. from the end, reverse in the chuck, and put a $\frac{3}{8}$ in. parallel reamer through the hole. Mill or saw and file away the segment as shown in the drawing, and drill and tap a hole in the thickness for a $\frac{1}{8}$ in. or 5 BA setscrew.

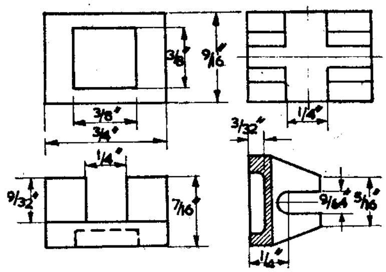
ASSEMBLY OF CRANK AXLE

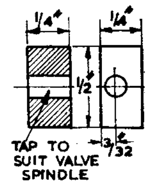
Put the stop collar on the longer end of the crank axle segment outwards, next the eccentric with the flange outwards, then the axle box for the right-hand side of the engine, also flange outwards. The left-hand axle box goes next the crank.

Jam a piece of metal between the crank webs so that the wheel can be pressed on (balance weight opposite crank) without bending the webs or otherwise distorting the axle. Then put the other wheel on the opposite end, setting the crank pins at right angles by the method described for other engines in these notes.



Right: The eccentric and stop collar

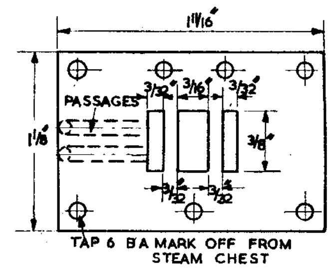




Left: *Slide valve and nut*

Right: *The port face*

Below: *The cast steam chest and alternative built-up steam chest*



You needn't bother about "mike" measurements on this particular job, for a reason you'll see in a minute. Put the assembly in the frame, making sure the axle boxes are in the right hornslots, and put in the hornstay screws.

COUPLING-RODS

The coupling-rods can be milled or sawn and filed from $\frac{3}{16}$ in. × $\frac{1}{2}$ in. mild steel, but anybody who hasn't a milling machine but gets aching arms when sawing and filing can use the following method.

Make the middle part of the rod from a length of $\frac{1}{8}$ in. × $\frac{3}{16}$ in. steel, sawing and filing a step at each end (see drawing) and brazing on a little block of $\frac{1}{2}$ in. × $\frac{3}{16}$ in. steel with a corresponding step in it. You can put a $\frac{1}{16}$ in. iron rivet through each joint to hold the bits together while brazing the joints. Then the only filing needed will be the bosses at each end. Drill the holes first (check the centres from the centres of your axles in case the latter aren't exactly to given measurements) and file the bosses to suit the holes.

One wheel should be pressed right home on the trailing axle (the straight one) and the other just put on as far as it will go by hand, the wheel seat being slightly eased for that purpose. Put a coupling-rod on the pressed side, then put on the other rod, adjusting the wheel until the rod goes easily on the crank pin, and the wheels will turn.

The crank pin in the driving wheel will have to be temporarily lengthened to bring it out level with the pin in the other wheel, naturally, but this is easily done by chucking a piece of $\frac{3}{16}$ in. mild steel rod, facing, centring, drilling No 40 and tapping to screw on the threaded end of the crankpin.

Adjust the unpressed wheel until both pairs of wheels will spin freely without any binding of the coupling-rods; then remove the "patent" crank pin extension, press home the last wheel, put on the coupling-rods and secure them with nuts and washers. The ordinary commercial kind will do quite well. The coupling-rods should be easy on the pins, but not slack. If too tight they will bind when the axle boxes move up and down on an uneven line.

THE CYLINDER

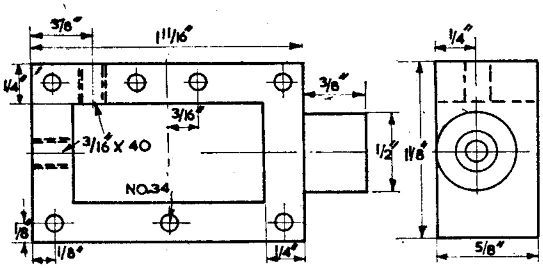
Castings should be available for the cylinder, but it can also be made without castings if a piece of $1\frac{1}{4}$ in. square rod of good quality bronze or gunmetal is available, about $1\frac{3}{4}$ in. long. Chuck this (or the casting) truly in the four-jaw; the solid piece should be centred, drilled $\frac{3}{16}$ in., then opened out with $\frac{5}{8}$ in. drill, and finally bored to slightly under size.

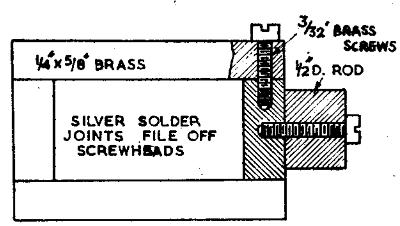
The casting will be cored, so bore out the core hole to similar size if an $\frac{11}{16}$ in. parallel reamer is available. Then ream as described for *Zoe*; a four-jaw chuck big enough to take the cylinder block will have a hole in it large enough to let the reamer go through far enough to form a true bore.

If no reamer is available just bore to size, taking the last two cuts without shifting the cross slide, then face off the end. The other end is faced off with the cylinder set up on a stub mandrel held in the chuck.

The portface and bolting face can both be trued up with the cylinder mounted end-up on an angle plate with a bolt through the bore, as previously described—or the block may be mounted in the four-jaw, as it is rectangular and not very large. Note that both the bolting face and portface are $\frac{5}{8}$ in. from the centre of the bore.

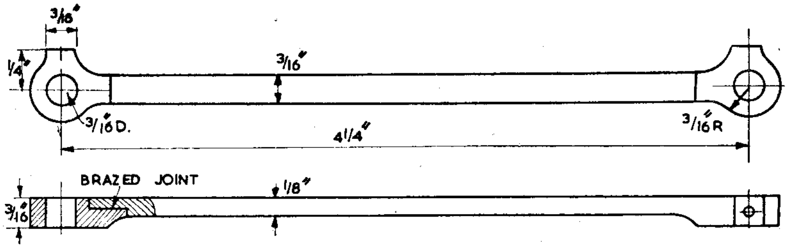
The ports can be marked off and cut as described for *Zoe* and *Virginia*. It doesn't matter if the ends are rounded instead of square as shown, but they must not be more than $\frac{3}{8}$ in. long. Only two 3/32 in. or No 40 holes are required for passageways between the port and cylinder bore. I would remind beginners that outsize passageways are a mistake, as they only have to be filled with steam twice in each stroke, the steam being blown to waste when the exhaust port opens. So long as they can pass the steam required to run the engine without throttling it they are all right.





The cylinder covers, glands, piston and rod are all made in exactly the same way as described for the $1\frac{3}{4}$ in. gauge *Zoe*. Four 3/32 in. or 7 BA screws will be sufficient to attach the covers. At the spacing shown there will be no risk of the screws interfering with the ends of the passageways.

Incidentally, be careful when drilling the exhaust way. If the hole for the exhaust pipe is drilled in the top of the cylinder block exactly above the exhaust port and 7/32 in. from the edge of the portface, using a 7/32 in.



drill, a No 21 drill can be put down it at a slight angle (see section through exhaust port) and this will cut right into the port—at the same time clearing the cylinder bore with room to spare.

STEAM CHEST AND SLIDE VALVE

The steam chest can be cast or built up. If cast, chuck in the four-jaw and face off each side, then chuck endwise with the gland boss running as truly as possible. Turn this to size, face off, centre, drill through with a No 30 drill and feed in the drill until it goes right through the opposite end of the steam chest and locates the hole for the oil nipple. Open out to $\frac{3}{8}$ in. depth with a 7/32 in. drill and tap $\frac{1}{4}$ in. × 40. Turn the gland from $\frac{5}{16}$ in. hexagon rod.

Open out the hole in the other end with a 5/32 in. or No 22 drill and tap $\frac{3}{16}$ in. × 40. Drill another 5/32 in. hole and tap it likewise for the steam pipe, at $\frac{3}{8}$ in. from the end farthest away from the gland boss and in line with the horizontal one. Finally, drill the seven No 34 screwholes and smooth off any burring by rubbing the contact faces on a sheet of fine emerycloth laid on any true surface such as the drilling-machine table.

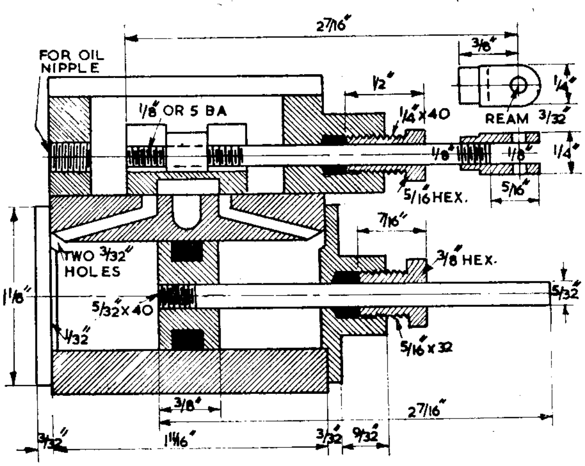
Clamp the steam chest temporarily to the cylinder portface and run the No 34 drill through all the holes, making countersinks on the portface. Remove chest, drill the countersinks No 44 and tap 6 BA.

The cover is a piece of $\frac{1}{8}$ in. brass plate $1\frac{1}{8}$ in. wide and $1\frac{11}{16}$ in. long. Clamp it to the steam chest, run the 34 drill through the lot and countersink the holes on one side, then true it up on a sheet of emerycloth as indicated.

A built-up steam chest can be made with two pieces of $\frac{5}{8}$ in. × $\frac{1}{4}$ in. brass rod $1\frac{11}{16}$ in. long and two $\frac{5}{8}$ in. long. Set them together to form a rectangle and put a 3/32 in. brass screw at each corner to hold them. Part off a $\frac{3}{8}$ in. length of $\frac{1}{2}$ in. round brass rod for the gland boss and attach that by another screw. Then silver solder all four corners and the gland boss, and finish off as described for the cast steam chest, fitting a similar cover.

Above: *The coupling rods*

Right: *Section of the cylinder*



Below: *Back end of the cylinder and section through the exhaust port*

The slide valve calls for a block of gunmetal or bronze measuring $\frac{9}{16}$ in. × $\frac{7}{16}$ in. and $\frac{3}{4}$ in. long. The exhaust cavity can be endmilled out or chipped as described for *Zoe*. It is essential that the groove for the nut is cut to an exact fit for same, so either mill it by clamping the valve on end under the slide-rest toolholder and traversing it across a $\frac{1}{4}$ in. end mill or slot drill in the three-jaw—or else clamping the valve in a machine vice on the lathe saddle and traversing it under a $\frac{1}{4}$ in. end-and-face cutter on an arbor between centres.

Take care to avoid cutting into the exhaust cavity. If you are unlucky, the trouble can be remedied by cutting a piece of 18-gauge brass or copper to the shape of the cavity, fitting it in and silver soldering it.

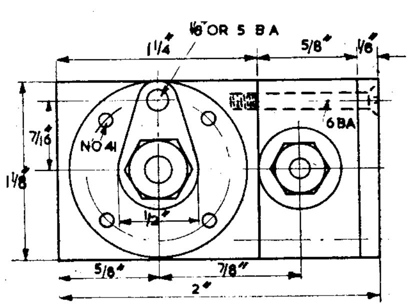
The easiest way to cut the groove for the valve spindle is to drill a 9/64 in. hole longways through the valve at $\frac{1}{4}$ in. from the bottom, then saw down to it from the top, filing away the sawmarks with a flat file and leaving the groove the same width as the hole. Bevel off each side of the valve as shown, and true up the working face as mentioned.

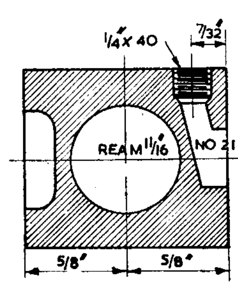
The valve spindle is a $2\frac{1}{4}$ in. length of $\frac{1}{8}$ in. rustless steel or drawn bronze rod, with $\frac{3}{8}$ in. of $\frac{1}{8}$ in. or 5 BA thread on one end and full $\frac{1}{8}$ in. on the other. The latter end is furnished with a fork or clevis made from $\frac{1}{4}$ in. square rod by the method described for valve-gear forks, to the dimensions shown.

The nut is a $\frac{1}{2}$ in. length of $\frac{1}{4}$ in. square brass rod, with a No 40 hole drilled through it and tapped to suit the valve spindle. This hole should be as close to one of the facets as possible so that when the whole bag of tricks is assembled—as shown in the complete section—the nut doesn't bear on the bottom of the groove. The valve should be able to lift off the portface about 1/64 in. when erected. Steam pressure keeps it in contact with the face when the engine is working.

When assembling, pack the piston with a ring of square-braided graphited yarn as described for previous engines; use the ordinary stranded

● *Continued on page 280*





Do not forget the query coupon on the last page of this issue

READERS' QUERIES

This free advice service is open to all readers. Queries must be on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling, cannot be given: stamped addressed envelope and query coupon with each query. Mark envelope "Query," Model Engineer, 19-20 Noel Street, London, W1.

Stainless-steel axles

I am building LBSC's *Speedy*. The axles are of stainless steel, but since fitting them I have been told this material is unsuited to plain bearings. Can you tell me whether or not this is the case?—H.M., Cefn, Denbighshire.

▲ *If the stainless steel which you have used for the axles of your* SPEEDY *is of a good free cutting quality it is quite suitable for use in plain bearings. However, it is absolutely essential to make sure that all the bearings are properly lubricated, even if they are made of bronze. In addition, the axles should run perfectly freely in the bearings. If these points are carefully provided for you should have no trouble.*

Destroyer modelling

I wish to construct a scale model of a Daring or Battle class destroyer. I should be grateful if you could tell me where I might obtain a detailed plan of one of these.—A.W., Wembley, Middx.

▲ *You could get an excellent detailed plan of a Battle class destroyer, to the scale of ⅛ in. to 1 ft, from Norman A. Ough,* 98 *Charing Cross Road, London, WC*2. *The drawing, which is of HMS* CADIZ, *was reproduced with pictures in "Ships and Ship Models" for September* 1954.

A sectionalised drawing of a Daring class destroyer by Laurence Dunn, again with illustrations, was published in "Ships and Ship Models" for April 1954, *but this was not a scale drawing.*

Suitable gauge

I am proposing to erect an elevated continuous track with straights of 50 ft and maximum curves of 14 ft radius. What gauge should I lay for passenger-carrying and which of LBSC's locomotives would be most suitable for it?—J.W.W., Bexleyheath, Kent.

▲ *With curves of* 14 *ft radius it should be possible to run quite successfully a* 3½ *in. gauge* 0-4-0 *tank engine such as* JULIET. *This gauge is the smallest on which* 14 *ft radius curves are really safe for passenger-carrying, but the short radius will make it impossible for you to use a six-coupled engine of any length. If, however, you would prefer a six-coupled wheeler then* P. V. BAKER, *a* 3½ *in. gauge* 0-6-0 *side tank engine, would just manage it comfortably so long as the flanges were removed from the middle wheels.*

Loco building

I would appreciate information on the following questions:

1 In assembling locomotive cylinder covers and valve chamber on to a cylinder and valve cover is it necessary to use a gasket to make the assembled parts steam tight?

2 What is the radius of curvature for the angle joining the flange and tread on locomotive wheels in 3½ in., 5 in. and 7¼ in. gauge?

3 What is tread angle, if any, for locomotive wheels in the above listed gauges.

4 The minimum track radius for *Tich.*

5 A comparison or listing of American and British wire gauges, etc.

6 In brazing copper boilers with an oxygen acetylene torch, must the whole boiler be preheated prior to brazing to prevent expansion and contraction stresses?

7 Which would be preferable for 7¼ in. gauge locomotive building: a vertical or a horizontal milling machine?—W.F.W., Miami Beach, Florida.

▲ 1 *There is no absolute necessity to use a gasket when assembling the valve chest and valve covers. A good close fit plus a thin coating of plumber's jointing should do the trick.*

2 *There is no definite decision as to the radius of curvature for locomotive wheels between the flange and the tread provided that a radius is definitely there. The chief point is that the inside face of the flange should preferably slope away from the rail head to a slight extent as this tends to overcome the tendency for the wheels to bind on a curve.*

3 *The standard angle for the slope of the tread is three deg. or* 1 *in* 20.

4 *The absolute minimum radius that* TICH *would negotiate is* 12 *ft.*

5 *A comparison of British and American wire gauges, etc., can be found in any good mechanical engineer's notebook, one of which is published by E. and F. Spon, of New York.*

6 *When brazing copper boilers the whole boiler should be pre-heated prior to brazing.*

7 *A vertical milling machine is the better for model locomotive building.*

Copper wire

Some time ago I purchased from a London firm some enamelled copper wire. I now require a further supply, but unfortunately I have lost the address of this company. I should, therefore, appreciate it if you can put me in touch with a supplier.—K.H., Barnoldswick, Lancs.

▲ *You can obtain all sizes and varieties of electrical instalment wires from the London Electric Wire Company and Smiths Ltd. (Lewcos).* 24 *Queen Anne's Gate, Westminster, London, S.W.*1. *If you write to this address they will probably let you have information about a local stockist.*

ROSE By LBSC

Continued from page 379

are in running position. Screw a piece of $\frac{3}{16}$ in. pipe into the tapped hole in the steam chest and connect a motor-tyre pump to it; I use old tyre valves for adapters, the outer ends being turned down and screwed to suit whatever size of pipe needed.

Turn the wheels in a forward direction until the crank is just past dead centre; then, if the pump is operated gently, the wheels should turn evenly and smoothly, with sharp beats from the exhaust hole in the cylinder. Next turn the wheels backwards, to the same position as the crank, and the result should be the same. If the pump is vigorously operated, the wheels should spin like a buzz-saw and the exhaust should sound like a miniature machine-gun.

As the lubricator won't work when the engine is operated by air (steam condenses in it and the resulting water lifts the oil to the outlet) it is advisable before attaching the tyre pump to squirt a few drops of oil—motor engine oil will do for this—into the steam chest. But don't put your head over the exhaust outlet when you start pumping! Next stage will be the boiler.

● *To be continued*

ROSE

LBSC now tells you how to make and fit the motion work on this beginner's 2-4-0 engine

Continued from 22 August 1957, pages 270 to 272

SOME years ago I fixed up an old commercially-made tank engine with some new parts, among which were single round-section guide bars and L-shaped crossheads. They were used both for quickness and simplicity, and proved quite satisfactory so I have adopted the same kind of components for the job in hand.

The guide bar is a 2 in. length of $\frac{1}{8}$ in. round silver steel with $\frac{3}{16}$ in. of $\frac{1}{8}$ in. or 5 BA thread on one end. Hold the rod in the chuck and screw it with a die in the tail-stock holder so that the thread is true. When screwed into the tapped hole in the gland boss on the cylinder, it should be parallel with the piston-rod—and see that it is or you'll have trouble when erecting !

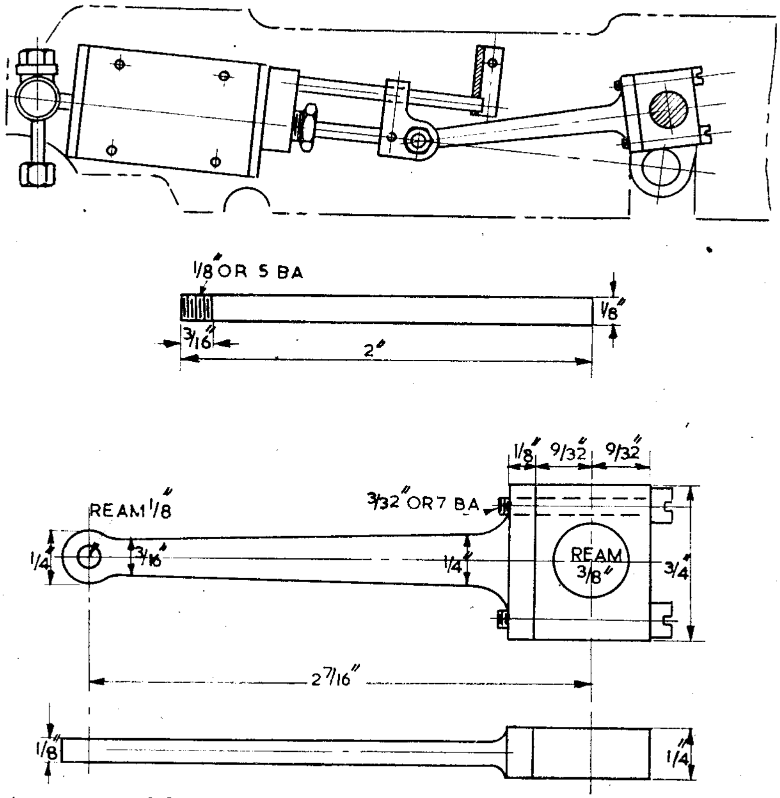
The motion bracket which supports the outer end of the guide bar is merely a piece of 16-gauge sheet steel $\frac{11}{16}$ in. wide, bent over at each end to fit nicely between the frames. That job can be done in the bench vice. At $\frac{5}{8}$ in. from the end and $\frac{1}{8}$ in. from the bottom, drill a No 30 hole for the end of the bar, but don't erect it yet.

The crosshead is made from a piece of $\frac{5}{16}$ in. × $\frac{5}{8}$ in. rod (brass or steel) about $\frac{7}{8}$ in. long. Scribe a line down the middle of one narrow side, make a centre pop on it at $\frac{3}{16}$ in. from the end and another at $\frac{7}{16}$ in. farther along.

The first is drilled No 23 for the piston rod and the other for the guide bar, using No 30 drill, and, as these two holes must be dead parallel, either use the drilling machine with the piece held in a machine vice or else chuck in the four-jaw with each pop mark running truly in turn and drill from the lathe tail-stock. The piston rod may be screwed into the crosshead if you prefer it; in that case drill both holes No 30 and tap the first one 5/32 in. × 40, screwing the end of the piston rod to suit.

Drill the hole for the crosshead pin No 32—that merchant must go through exactly at right angles to the other two—and ream it $\frac{1}{8}$ in. The crosshead can then be filed to outline. The slot for the end of the connecting-rod can be end-milled by clamping the crosshead on its side under the lathe toolholder, at centre height, and traversing it across a $\frac{1}{8}$ in. end-mill or slot drill in the chuck.

The crosshead pin, or wrist pin as it is sometimes called, is just a $\frac{3}{8}$ in. length of $\frac{1}{8}$ in. silver steel turned down and screwed at each end to the dimensions shown.



Arrangement of the motion; guide bar; connecting-rod

THE CONNECTING-ROD

The marine type of connecting-rod is about the easiest to make and fit, and is adjustable for wear. To make the brasses saw or part off two pieces of $\frac{1}{4}$ in. × $\frac{5}{16}$ in. (if not available use $\frac{5}{16}$ in. square) a full $\frac{3}{4}$ in. long. Put the two $\frac{1}{4}$ in. sides together and hold them thus with a toolmaker's cramp, then solder them.

Don't take the cramp off, but make a centre pop right in the middle of the joint. The cramp will prevent their coming apart while the pop mark is made. Then take off the cramp, chuck the piece in the four-jaw with the pop mark running truly, open it with a centre drill, drill through with $\frac{1}{8}$ in. drill, following up with 23/64 in. and finally reaming $\frac{3}{8}$ in.

If $\frac{5}{16}$ in. square material has been used, face off $\frac{1}{16}$ in. while still in the chuck to bring the thickness to $\frac{1}{4}$ in. Then rechuck the piece so that one end projects, and face that off truly, repeating the operation on the other end, then top and bottom, until the piece measures $\frac{9}{16}$ in. × $\frac{3}{4}$ in. with the reamed hole in the middle.

Scribe a line down the middle of the $\frac{3}{4}$ in. end, and at 3/32 in. from each end of the line make a centre pop. Chuck in the four-jaw with each of these running truly, and drill right through the thickness of the piece with a No 41 drill. These holes are for the screws.

There is no need to seek out a friendly blacksmith to forge the rod. Just saw off a piece of $\frac{1}{8}$ in. × $\frac{1}{4}$ in. mild steel $2\frac{3}{8}$ in. long, chuck truly in the four-jaw and turn a pip on the end $\frac{1}{16}$ in. dia. and a full $\frac{1}{8}$ in. long. Saw off another piece $\frac{7}{8}$ in. long and drill a $\frac{1}{16}$ in. hole in the middle.

Put the pip in the hole so that the

ROSE . . . . continued

two pieces form a tee, and braze the joint; just smear with wet flux, heat to bright red and touch the joint with a bit of soft brass wire or a $\frac{1}{16}$ in. Sifbronze rod, letting the melted metal form a fillet. Quench in cold water and clean up.

Before filing to shape temporarily clamp the brasses to the head of the tee, and run a No 41 drill through the screwholes, making countersinks on the tee. Measure the distance from the centre of the reamed hole in the brasses to the location of the hole for the crosshead pin at the other end, and make a centre pop at that point. Drill it No 32 and ream $\frac{1}{8}$ in.

Take off the brasses, drill the countersinks in the tee-head No 48 and tap 3/32 in. or 7 BA. Mark out the shape of the rod, setting out the little-end boss around the hole for the crosshead pin, then file to shape.

Before parting the brasses make a mark on each (pop mark or figure) so that when parted they can always be put together again in the original way. Heat them until the solder melts, wipe off any surplus, then assemble the lot with two long screws as shown.

These can be home-made, turning them from 5/32 in. round steel, or they can be made from $\frac{7}{8}$ in. lengths of 3/32 in. silver steel with a few threads on each end. Screw one end into the tee, put on the brasses and secure them with commercial nuts.

THE ERECTION

Put the little-end of the connecting-rod in the slot in the crosshead and put the pin in. Push the crosshead over the guide bar and enter the piston rod in the hole in the crosshead. Take off the brasses, drop the whole assembly in place in the frames and temporarily fix the cylinder by putting a couple of screws at each side. Put the brasses over the crankpin and couple up.

Place the crank on back dead centre, with the piston rod fully extended. This will automatically line up the guide bar with the piston rod. Put the motion plate in position with the end of the guide bar going through the hole provided, and put a tool-maker's cramp at each end to hold the flanges tightly against the frame while the crosshead is adjusted to its exact position.

Turn the wheels until the piston rod is right home and the piston hits up against the front cylinder cover; the crank should then be on the front dead centre. Take off the cover and carefully drive the piston in 1/32 in. so that the rod will enter the crosshead by that much more.

If the piston rod is screwed into the crosshead make the adjustment by turning the rod. Then take out the whole bag of tricks, drill a No 53 hole through crosshead and piston rod, and squeeze in a little bit of $\frac{1}{16}$ in. silver steel to act as a cotter.

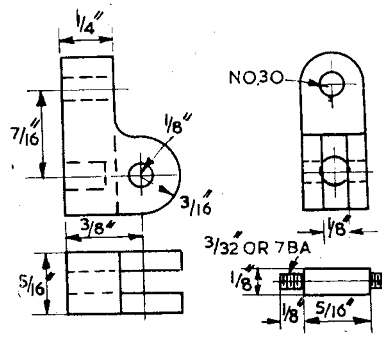
Replace the assembly, couple up the big-end and see if the wheels turn freely by hand, the crosshead sliding up and down the bar without any tight places. If all right, the motion plate can then be fixed either by drilling and tapping the flanges for the screws through the holes already in the frame, or by drilling clearing holes through the flanges with a No 41 drill and using screws nutted inside the frame.

ECCENTRIC-STRAP AND ROD

If the casting for the strap has any rough spots on it, clean it up with a file, then centre pop the side lugs or ears and drill them No 48. Make a couple of marks on one side—the same as the big-end—then grip the strap in the bench vice with half the lugs showing above the jaws and saw across with a fine-tooth hack-saw using the tops of the vice jaws to guide it.

Tap the holes in the stepped half 3/32 in. or 7 BA and open out the holes in the other half with a No 41 drill, smooth off any sawmarks and screw the halves together. Chuck in the four-jaw with the corehole running as truly as possible, face off the side and bore out the corehole to a nice running fit on the eccentric. For a gauge I always use a piece of rod turned to the same size as the eccentric. Face the other side on a stub mandrel.

The easiest way to slot the other lug for attaching the rod is to hold it in a machine vice (regular or improvised with bits of angle and screws) on the lathe saddle and traverse it under a 3/32 in. saw-type cutter on an arbor between centres.



Crosshead and pin

It can also be cut by hand with a little care, slotting first with a hack-saw and finishing with a keycutter's warding file.

The rod itself is a simple filing job, using $\frac{3}{8}$ in. × 3/32 in. steel strip or any offcut of sheet steel that might be handy. Drive it into the slot and

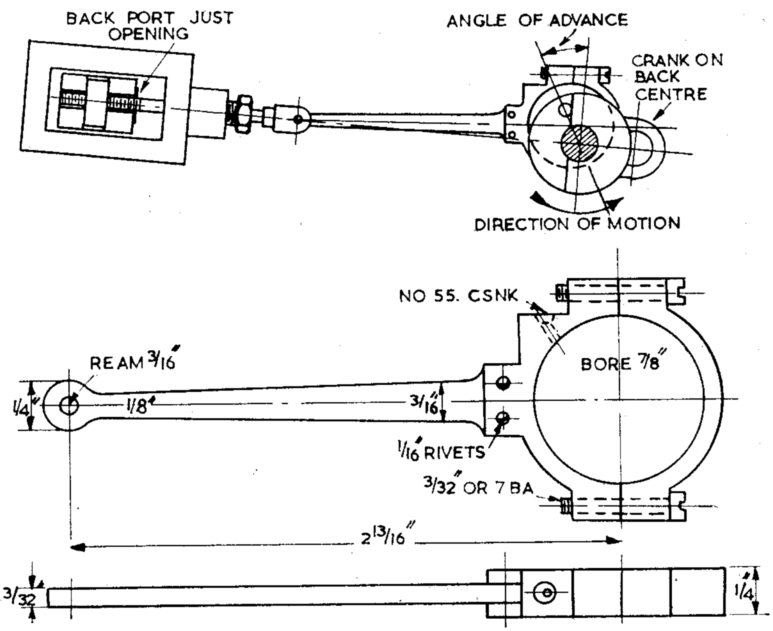


Diagram of the valve setting; eccentric strap and rod

solder it, putting two $\frac{1}{16}$ in. rivets in for extra security. Put the strap over the eccentric and make sure it fits correctly, then proceed to set the valve.

VALVE SETTING

Take out the cylinder, remove the steam chest and replace cylinder with a couple of screws at the side to hold it in position. Prop up the chassis on its side with the port face of the cylinder upwards; I usually grip one of the beams in a small machine vice on the bench, which allows the wheels to be turned. Take the slide valve and spindle out of the steam chest and put the valve on the port face, coupling up just the same as shown in the illustration.

Tighten the screw in the stop collar, turn the wheels by hand and watch the valve movement; guide it in a straight line with a piece of wire or anything else handy. The ports should open an equal amount at each end of the movement; if they don't then adjust the nut by turning the spindle.

When you get equal openings put the crank in the postion shown in the diagram on back dead centre. Slacken the setscrew in the stop collar and turn it until the edge of the back port is showing at the end of the valve (see drawing).

Tighten the setscrew and turn the wheels in the direction of the arrow until the crank is on front dead centre. The edge of the front port should then be showing. If it isn't, the valve is a wee bit too long; take a little off *both* ends to keep the cavity in the middle, and have another shot.

When you get that bit satisfactory turn the wheels the other way. Watch the valve carefully; if the ports crack on the dead centres, the setting is all right for going either way. If, however, the port cracks *before* dead centre, the shoulder of the stop collar against which the stop pin is bearing needs a little filing off it.

Contrariwise if the port doesn't crack until *after* dead centre, the shoulder needs building up, which can be done by soldering a little piece of brass to it. When the ports crack on dead centre when the wheels are turned in either direction, the valve setting is correct.

Now note carefully: whatever else you may do *don't on any account alter the position of the nut on the slide-valve spindle when reassembling the whole works.* If you do you've had it.

What I usually do is to drill a small hole, say with a 60 drill, through the nut and spindle, and squeeze a bit of a domestic pin in it. That prevents the nut from moving accidentally, and when replacing the nut on the spindle after inserting it into the steam chest all there is to do is to turn the spindle until the holes in the spindle and nut coincide and you can push in the fragment of pin.

THE LUBRICATOR

All that remains to complete the working parts is a lubricator. The tank is a piece of $\frac{1}{2}$ in. brass or copper tube about 22-gauge and $1\frac{3}{4}$ in. long. Square off the ends in the lathe. It should fit nicely between the angles holding the frame to the buffer beam; if the ends of the screws project through file them off.

Drill a $\frac{3}{8}$ in. hole in the middle, and in it fit a $\frac{1}{4}$ in. $\times$ 40 bush for filling. Directly opposite drill a No 32 hole, and in that fit a $\frac{1}{2}$ in. length of $\frac{1}{8}$ in. tube with a few threads on one end. This is for draining out the condensate water. Fit a disc of 16-gauge copper in each end.

To make the nipple chuck a piece of $\frac{5}{16}$ in. hexagon brass in the three-jaw, face the end and turn down $\frac{1}{2}$ in. length to 5/32 in. dia. Part off at a full $\frac{1}{4}$ in. from the shoulder. Reverse in the chuck, turn down 5/32 in. length to $\frac{3}{16}$ in. dia. and screw $\frac{3}{16}$ in. $\times$ 40.

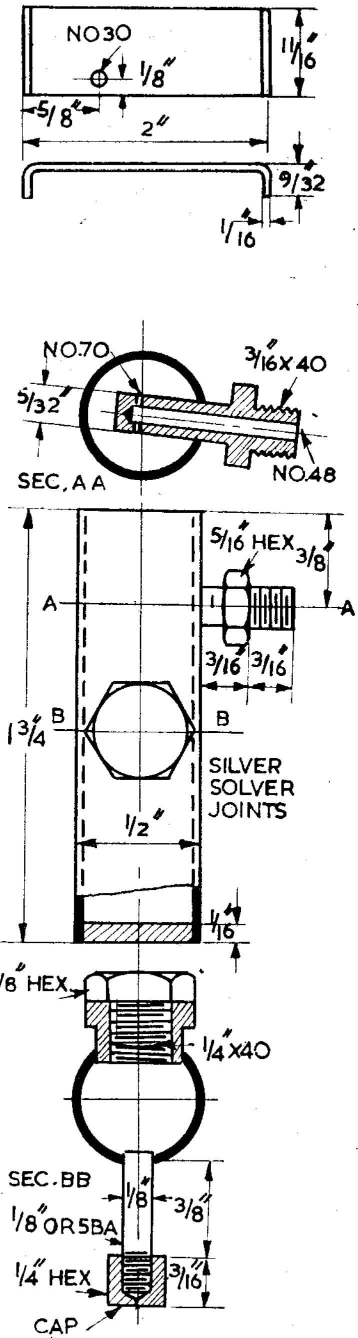
Centre and drill No 48 to $\frac{11}{16}$ in. depth. At $\frac{1}{8}$ in. from the blind end drill a No 70 hole into the central hole, as shown in the section. Next drill a No 22 hole in the tank at $\frac{3}{8}$ in. from the right-hand end, and fit the nipple into it slightly on the slant, at the same angle as the cylinder in the frame. Make quite sure that the No 70 hole is at the top—very important that.

Now silver solder all the joints at one heating. Pickle, well wash and clean up, then screw the nipple into the tapped hole in the front end of the steamchest. When right home the tank should be horizontal, with the filler bush at the top and the drain pipe hanging vertically, as shown in the arrangement of the motion drawing.

The filling plug is turned from $\frac{3}{8}$ in. hexagon brass rod and needs no detailing. The cap for the drain pipe is made from $\frac{1}{4}$ in. hexagon brass rod, in the same way as a union nut except that it has no thoroughfare hole in it.

The cylinder with all its attachments can now be permanently erected. The little-end of the eccentric rod should be attached to the fork on the valve spindle by a 3/32 in. or 7 BA screw with 5/32 in. of plain under the head; or the holes in the fork may be reamed 3/32 in. and a silver-steel pin fitted with nuts on both ends.

Avoid any slackness, as it upsets the valve setting, and be sure that the setscrew in the stop collar is well tightened up and not close enough to the eccentric to cause it to bind.



Lubricator and motion bracket

To test by air pressure, block up the beams so that the wheels are clear of the bench. See that the $\frac{1}{8}$ in. pieces of packing are between the bottoms of the coupled axleboxes and the hornstays, so that the boxes

● *Continued on page* 383

ROSE This week LBSC begins the description of a simple boiler for this locomotive

Continued from 12 September 1957, pages 377 to 379

THE spirit-fired water-tube boiler which I am specifying for the beginners' engine is based on a considerable amount of experimenting which I did a good while ago. Before going into details of it I thought that maybe a little dissertation on the evolution of this type of boiler might be interesting to readers who are new to our craft, so here is a brief history.

Around the turn of the century there was an enthusiastic locomotive-builder who did not care for the amount of work involved in building regular locomotive-type boilers with internal fireboxes and tubes. At the same time he realised the shortcomings of the "pot" boiler, which was easy enough to make, being merely a plain tube with closed ends, and which was heated by three or four spirit-burners underneath, but the flames could be deflected by a slight puff of wind, or even by the movement of the engine itself. The result was loss of steam.

This enthusiast, Fred Smithies by name, started in to design a simple type of boiler that was windproof, and also a good steamer. He tried adding various kinds of flame shields to the plain boiler barrel, and he tried enclosing the burners in a kind of firebox casing under the barrel, with a duct or flume leading from it to the front end. A vertical tube went through the barrel at that point, and the chimney was fitted on top of it.

By discharging the exhaust steam into the tube, a draught was created which sucked the flames along the duct. This boiler was a great improvement on the open-flame type, but the heating surface was limited to the space enclosed by the firebox casing and the duct.

Suddenly Fred got the idea that if he put the "pot" boiler inside the shell of an ordinary locomotive-type boiler, the whole problem would be solved at one fell swoop. The burners would be completely shielded, and the whole of the boiler-barrel would be in the hot gases, so should steam well. He tried it out, and it worked. The boiler-barrel projected through a hole in the backhead of the shell, and the fittings were attached to it direct. The front end of the barrel was supported by a stud.

Various improvements were added. Fred put three water-tubes in the bottom of the barrel. These were bent up at each end, and fitted on the slant, to increase heating surface and help circulation. The barrel was attached to a cast backhead which did away with the need for a front end support.

Anyway, to cut a long story short, Fred applied his boiler to a small four-coupled tank engine with a single cylinder. This "astonished the natives" by running for about an hour on a small continuous indoor track, hauling one coach. It was an outstanding performance for those days!

Variations and developments

The idea was soon adopted commercially, and "internally-fired" locomotives soon appeared on the market. Also there was the usual batch of "I-thought-of-it-first" merchants, one of whom claimed to have converted—some ten years before—a locomotive built by Stevens' Model Dockyard of Aldgate! Some of the firms producing the commercial locomotives with the Smithies boiler added variations, such as a larger number of smaller water-tubes, and a cast backhead with a water space cored in it, into which the tubes were fitted at the back end.

I had plenty of experience with the boilers, and found out a lot about them. A friend bought one of the commercial engines and after a while it became a very poor steamer. He asked if I would fit an oil-burner to it, to ginger it up a little.

I did so, and on trying it with the oil burner, one of the watertubes burst. The makers had fitted seven $\frac{3}{16}$ in. water-tubes under the barrel, practically touching, and with very little slant. In fact the front ends of the tubes were touching the barrel for 3 in. or so before turning up at the ends to enter it right at the front end.

What happened was that, owing to the bad circulation, four of the tubes had become choked with scale and dirt at the firebox end. This was the cause of the bad steaming with the original spirit-lamp. The water-tube which burst was choked solid, and the intense concentrated heat of the oil-burner which I fitted just melted it.

Another firm fitted cast backheads with a narrow water space at the bottom. This also became choked with "fur" like that sometimes seen in domestic kettles. It blocked the ends of the water-tubes, and they just burnt out.

Although the boilers would steam, they were very inefficient owing to the enormous amount of heat wasted through the outer casing. The "heating surface" of the casing was much greater than that of the actual boiler! The only paint that would stand up on the casings was the black heat-resisting kind at one time used for the exhaust-pipes of motor-cycles. The usual coloured paint burnt off at the first time of lighting-up.

An improved version

So far I had taken very little interest in the water-tube boiler, as I much preferred the regular locomotive-type. Then a circumstance arose which altered matters. The boilers of the locomotives made by one firm were provided with what their designer called a "downcomer." This was a flat rectangular casting with a curved flange which was attached to the barrel at the firebox end. It was hollow, and the rear ends of the water-tubes were attached to it. Water flowed into the downcomer through holes drilled in the underside of the barrel, thence through the tubes to the front end.

A correspondent who wrote to me about rebuilding an engine built by this firm said that the downcomer was choked with scale. I wasn't surprised in the least; but although I didn't favour the water-tube boiler, I appreciated that it had good points and was easy and cheap to construct, so thought maybe I could eliminate the sources of trouble.

I did a bit of experimenting, and the boiler specified for *Rose* incorporates the improvements that I tried out all those years ago. The backhead is made hollow, so that the whole surface is available for fittings, just as in a regular locomotive-type boiler, but instead of being cast, it is made from sheet copper and brazed.

A hole is cut in the inner plate and the barrel brazed into it. The water-tubes are fitted at the bottom, and have a good slope, like those of a Babcock and Wilcox stationary boiler. Also, they are quite straight; bends are eliminated by fitting them in the underside of the barrel in the manner devised by the late Tom Averill.

In districts where the water is bad, and scale is likely to form inside the boiler, a washout plug can be fitted at the bottom of the backhead, and the boiler regularly cleaned out. A screwed plug can also be fitted in the backhead opposite the end of each tube, and by removing these when washing out, a stiff wire with a tuft of flax at the end can be pushed right through and the tubes thus thoroughly cleaned.

Another objectionable feature of the spirit-fired boiler was the unpleasant fumes caused by the wicks burning in the confined space. This gained the nickname of "poison-gas plants" for the engines. As a matter of fact the unburnt vapour *is* detrimental to breathe, though not lethal, and will make the driver's eyes smart and water badly. I found that by fitting a blower and arranging the blastpipe and chimney just as in a coal-fired boiler, enough draught could be induced through the firebox to ensure complete combustion of the spirit.

This not only got rid of the fumes, but improved the thermal efficiency, as all the spirit was burned instead of some being evaporated unburnt. The efficiency was also much improved by the extra heating surface afforded by the lower part of the water-space backhead. Regarding heating surface, may I call the attention of beginners to the fact that it is not so much the *amount* of heating surface that makes a boiler steam, but the degree of heat applied to it? *Rose's* boiler will steam very well with the specified burners, but not with a candle in the firebox!

BOILER SHELL OR CASING

The best material for the casing of any water-tube boiler is sheet steel, which doesn't conduct the heat away like brass and copper. Steel tube can also be used for a small casing of the size shown, and if a piece $2\frac{1}{2}$ in. dia. and 22-gauge is available it will save making a longitudinal seam. Square off the ends to an overall length of 10 in. then saw across, split and open out to form the firebox as described for *Zoe* last week.

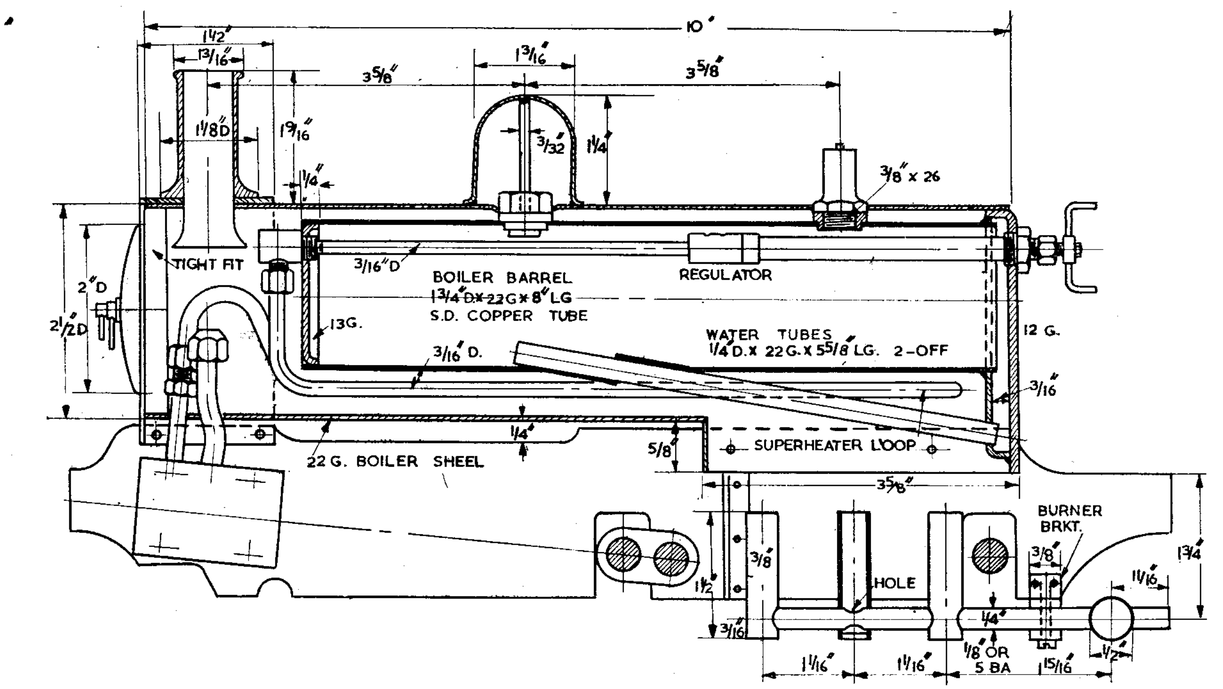
If made from sheet, a piece 10 in. $\times$ $8\frac{1}{4}$ in. will be needed. At $3\frac{1}{2}$ in. from one end of each longer side, make a sawcut or a snip with shears, 1 in. long. Bend to a $2\frac{1}{2}$ in. circle and put a few rivets through the overlap on the longer side of the snips (use $\frac{1}{16}$ in. iron rivets) then open out the metal on the shorter side of the snips, to form the firebox, the shape of which is shown in the cross-section. Fit a throatplate in the way described for *Zoe* but there is no need to braze either the longitudinal seam or the throatplate joints. The riveting will be quite sufficient as there is no water in the shell.

The smokebox wrapper is a strip of 16-gauge steel $1\frac{1}{2}$ in. wide, bent to the same shape as the firebox, and fitted over the front end of the barrel. Note—it must be left overlapping the front end of the barrel by $\frac{1}{16}$ in. so that the front will fit in flush. Attach the wrapper to the barrel by three $\frac{1}{16}$ in. rivets at each side just above where the wrapper diverges; see smokebox end view.

The smokebox front has a dummy door and adornments. It can be a casting or built up. If cast, it will only need the flange turning to a tight push fit in the barrel, and the sides trimming to fit flush in the wrapper. To build up, cut a plate of 16-gauge sheet steel, to fit inside the projecting part of the wrapper, butting up flush against the end of the barrel. The flange which fits inside the barrel is just a $\frac{1}{4}$ in. strip of 16-gauge steel bent into a ring which will fit tightly in the barrel, and brazed to the front plate.

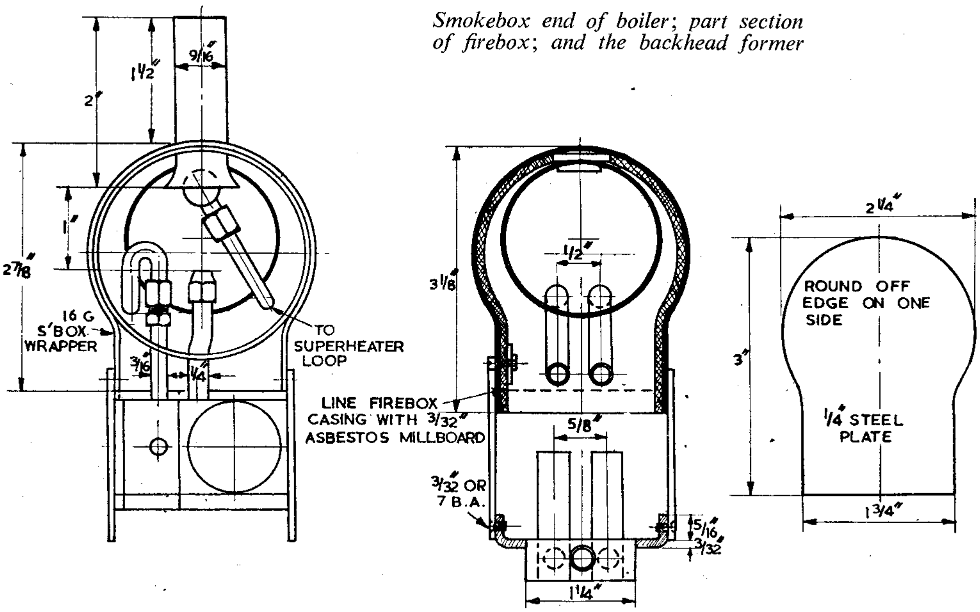
Tip—leave the front plate oversize until the ring is brazed to it, then file to the outline of the ring, so that when the ring is inserted in the barrel, the plate goes in flush with the wrapper. The door can be dished and turned from a 2 in. disc as described for other engines in these notes, and attached by a screw in the middle. Make the screw from a bit of $\frac{1}{4}$ in. round steel, and turn the head to simulate the handles. Fix with a nut on the inside.

Scribe a line along the top of the shell; make sure that it *is* on top, or



Arrangement of boiler, pipe connections and burner

Smokebox end of boiler; part section of firebox; and the backhead former



the chimney and dome will be "all cockeyed," as the kiddies would say. At $\frac{3}{4}$ in. from the smokebox end drill a $\frac{9}{16}$ in. hole and fit a 2 in. length of $\frac{9}{16}$ in. thin brass or copper tube in it. This should be belled out at the bottom, and project $1\frac{1}{2}$ in. above the barrel. Silver solder it in. For the dome and safety-valve bushes, drill $\frac{3}{4}$ in. holes along the scribed line at the spacing shown.

BOILER

First cut a forming plate to the size given, then cut out a piece of 12-gauge or 13-gauge sheet copper to same shape but $\frac{7}{16}$ in. larger all around except at the bottom. Flange this over the former as described for *Zoe* and file off any raggedness. Cut a piece of 16-gauge copper to fit inside the flange, and bend it over at the bottom as shown in the section. This serves as a foundation ring. Cut a hole $1\frac{3}{4}$ in. dia. in the upper part, to within $\frac{1}{16}$ in. of the top. Fit the plate inside the backhead flange flush with the edge of it, and braze it in.

This job can easily be done with a one-pint blowlamp or a small gas blowpipe. Just lay it on the coke in the brazing pan, cover the joints with wet flux, heat all over till the coke glows and the flux fuses, then concentrate the flame on one bottom corner. When bright red, apply a piece of easy-running brazing strip, which should melt and run in the joint. Then work right around slowly, feeding in the brazing material as the metal reaches the bright red heat.

Run a good fillet along the bottom. When through, let it cool to black, then pickle, wash off and clean up as described for *Zoe*. Coarse-grade silver solder can be used if desired.

Drill two $\frac{1}{4}$ in. holes in the plate just off the bottom and at $\frac{1}{2}$ in. centres for the water-tubes, then fit the barrel. This is a piece of $1\frac{3}{4}$ in. × 22-gauge seamless copper tube squared off at the ends to a length of 8 in. Don't use thicker material or the boiler will lose efficiency. Fit it in the hole in the plate, setting it square with the backhead, and silver solder it in, using coarse-grade silver solder. Before putting in the pickle, heat the whole length of the barrel to medium red, as it must be soft for fitting the water-tubes.

Next locate the holes for the safety-valve and dome bushes on the barrel from those in the casing. Push the backhead-and-barrel assembly into the casing leaving the backhead projecting $\frac{1}{16}$ in. Scribe circles on the barrel through the holes in the casing, centre punch the circles, and drill $\frac{3}{16}$ in. holes, opening them to 31/64 in. and reaming $\frac{1}{2}$ in. If you try to drill direct, the holes will be polysided in the soft thin metal. Turn up bushes to suit from $\frac{5}{8}$ in. rod (I always use copper for boiler bushes), tap them $\frac{3}{8}$ in. × 26 and fit them.

The front plate for the barrel is made exactly the same as the smokebox tubeplate for *Zoe* but to given sizes. It should fit the barrel tightly. At $3\frac{1}{2}$ in. from the front end on the underside of the barrel, drill two $\frac{1}{4}$ in. holes, at $\frac{1}{4}$ in. each side of the centre-line. Put a piece of $\frac{1}{4}$ in. steel rod in each in turn, and force it down on to the barrel until it assumes the slant of the water-tubes.

This will distort the holes so that the water-tubes—pieces of $\frac{1}{4}$ in. × 22-gauge copper tube $5\frac{5}{8}$ in. long—can be inserted as shown in the longitudinal section. The whole bag of tricks—bushes, front plate and water-tube joints—can then be silver soldered at the one heating. For this job use best-grade silver solder, or Easyflo and the special flux sold for use with it. Pickle, wash well, and clean up ready for attachment of the fittings, but don't fit the boiler permanently in the casing yet.

To keep the heat in and preserve the paint on the outside of the casing, the firebox end should be lined with asbestos millboard. This serves the same purpose as the firebrick lining on full-size stationary water-tube boilers. Cut a piece $3\frac{1}{2}$ in. wide, and mould it to the inside of the casing, as shown in the section at firebox. This is easily done if the material is dipped in water, which renders it flexible. If it is bent dry, it will crack and break.

To keep it in position, cut two thin strips of iron or tin about $\frac{3}{8}$ in. wide, put one along each side on the asbestos just above the bottom of the casing, and secure it with three 3/32 in. screws put through the lot—casing asbestos and strip—and nutted on the inside of the firebox. When the asbestos dries out it will set quite hard and prevent undue waste of heat through the casing. Next stage, the fittings for backhead and smokebox.

● *To be continued*

ROSE

LBSC gets down to the details of the fittings for the boiler of the beginners' locomotive

Continued from 26 September 1957, pages 448 to 450

Most of the water-tube boilers fitted to the commercially-made locomotives mentioned in my previous article had dry backheads. The inside boiler barrel was directly attached to a cast backhead, and as the water area was only equal to the diameter of the barrel, it was impossible to fit a water-gauge with an adequate length of glass, and direct large-bore passages.

They also had plug-cock regulators which either stuck or else leaked badly; and being screwed direct into the backhead, the steam inlet was so close to it that the surge of water when the engine started sent plenty of it down the steam pipe.

These troubles have been eliminated in the boiler for *Rose*. The entire surface of the backhead is in contact with water and is available for fittings. The regulator is an adaptation of a screwdown valve taking steam from near the middle of the boiler barrel, so is unaffected by surging. It can neither stick nor leak, and gives very fine adjustment of the supply of steam to the cylinder.

A standard type of water-gauge with ample length of glass is provided, and a blower of the type specified for *Zoe* can be fitted. The pipe passes through the water space. On the commercially-built engines mentioned above it passed through the casing, and when water went down the pipe, as it usually did, the effect resembled a person with a violent attack of sneezing.

REGULATOR

Use bronze, gunmetal or best quality brass rod for all the fittings. Chuck a piece of $\frac{5}{16}$ in. round, face the end and part off a $\frac{3}{4}$ in. length. Rechuck, centre, drill through with No 43 drill, open out and bottom to $\frac{1}{2}$ in. depth with 7/32 in. drill and D-bit, slightly countersink the end and tap $\frac{1}{4}$ in. × 40. Reverse in chuck and open out the other end to a bare $\frac{1}{8}$ in. depth with No 23 drill. Drill three No 50 holes in the side as close together as possible. Fit a $4\frac{1}{2}$ in. length of 5/32 in. copper tube with a few 5/32 in. × 40 threads on one end into the No 23 hole and silver solder it.

Chuck the $\frac{5}{16}$ in. rod again, centre and drill No 31 for $\frac{1}{2}$ in. depth. Turn down $\frac{3}{16}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. × 40. Part off at $\frac{3}{16}$ in. from the shoulder, reverse in the chuck, open out to a bare $\frac{1}{8}$ in. depth with a letter C or 15/64 in. drill, then tap the rest of the hole 5/32 in. × 32. Fit a 3 in. length of $\frac{1}{4}$ in. tube into the counterbore and silver solder it. This tube must have a hole through it large enough to pass a 5/32 in. rod. Run the tap through again after silver soldering.

Chuck a piece of $\frac{1}{2}$ in. rod, face, centre and drill No 21 for $\frac{3}{4}$ in. depth. Open out with letter C or 15/64 in. drill to a full $\frac{1}{8}$ in. depth. Turn down $\frac{1}{4}$ in. length to $\frac{3}{8}$ in. dia. and screw $\frac{3}{8}$ in. × 32. Part off at a bare $\frac{3}{8}$ in. from the shoulder, rechuck in a tapped bush, turn down 7/32 in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. × 40. Fit this on the other end of the $\frac{1}{4}$ in. tube (see drawing) and silver solder it. After cleaning, screw the two halves together as shown.

The regulator rod is made from a piece of 5/32 in. rustless steel or drawn bronze rod $4\frac{5}{8}$ in. long. Turn one end down to 5/64 in. dia. for a full $\frac{1}{8}$ in. length and screw it 9 BA. File the next $\frac{1}{8}$ in. to a 3/32 in. square. Reverse in chuck, turn a blunt cone point on the end, screw the rod 5/32 in. × 32 for about $\frac{3}{4}$ in. length and turn away the threads for $\frac{1}{8}$ in. behind the point. Put this through the gland fitting and push it down until the threads engage with the tapped section of the regulator body. Screw it right home until the cone point seats in the D-bitted hole, as shown in the section.

The gland nut is made just the same as a union nut and needs no detailing. Pack it with a few strands of graphited yarn.

The handle is made by screwing two pieces of 3/32 in. steel into the ends of a $\frac{5}{16}$ in. length of $\frac{3}{16}$ in. square rod and bending the ends at right angles. This is the same kind of handle as used on the old GER engines. Drill a 3/32 in. hole through the middle of the square piece of rod, and file or drift it square to fit the squared section of the spindle. It is secured by a 9 BA nut.

The next job is to mark out the position of the fittings on the backhead, as shown in the drawing, and drill and tap the holes, also those in the smokebox end of the barrel. Make a mark on the flange of the regulator gland, opposite those in the valve body, then insert the regulator through the large tapped hole in the backhead, and screw it right home.

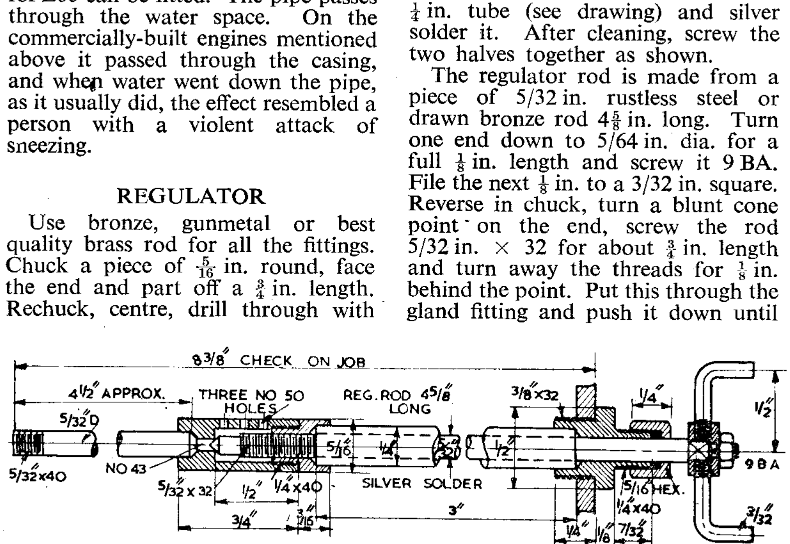
The holes in the body must be at the top, and the end of the steam pipe should just project through the upper hole in the front end plate. If the holes don't come right when the gland flange is screwed up hard against the backhead, put a soft copper washer of sufficient thickness to do the trick between the contact faces. A trial-and-error job ! Anoint the threads with plumbers' jointing as usual.

Mount the regulator handle on the rod so that when the valve is shut, the handle is top-right to bottom-left as shown in the view of the backhead. Turn anti-clockwise to open. Although the handle will clear the water-gauge and blower union, it shouldn't need turning as far as that. About one-third of a turn should pass enough steam for the engine to pull a good load at high speed.

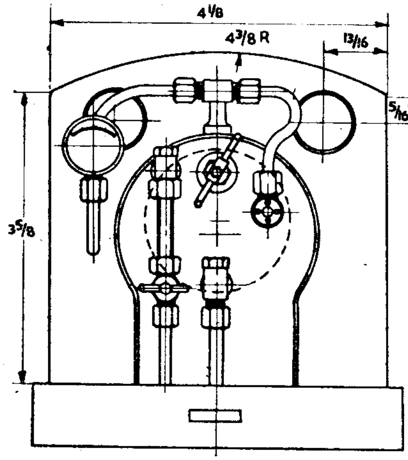
STEAM ELBOW AND SUPERHEATER

Chuck a piece of $\frac{3}{8}$ in. rod in the three-jaw, face, centre and drill to a bare $\frac{5}{8}$ in. depth with No 30 drill. Tap 5/32 in. × 40. Turn down $\frac{3}{16}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. × 40. Part off at $\frac{1}{2}$ in. from shoulder, drill a $\frac{3}{16}$ in. hole in the side at 7/32 in. from the blind end, and silver solder a $\frac{1}{4}$ in. × 40 union nipple into it.

Smear the outer threads with plumbers' jointing, also those on the end of the steam pipe projecting through the front plate, and screw the elbow on to the pipe, carrying on until the outer threads engage with

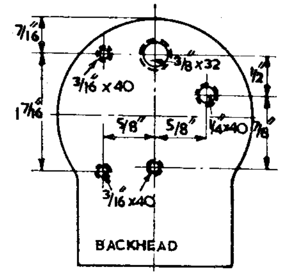


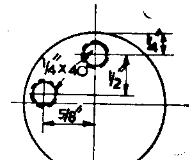
The regulator assembly

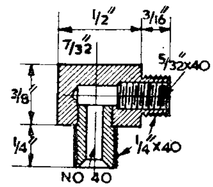


Left: *Arrangement of footplate fittings*

Right: *Location of the holes for fittings*

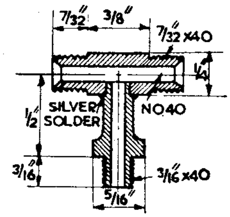






Left: *Steam-pipe elbow*

Right: *The steam tee*



those in the plate and the elbow is tight up against the plate. The union on the elbow should incline to your right.

The superheater is a piece of 5/32 in. copper tube 19 in. long, with a $\frac{1}{4}$ in. × 40 union nut and cone at each end. When silver soldering on the cones, heat the whole length of the pipe to red and put it in the pickle. Well wash afterwards, letting the water run through the pipe to shift any scale that might have formed.

Bend the pipe into a loop and insert it between the water-tubes and boiler barrel, then bend up one end at right angles and attach the nut to the steam elbow. The other end is bent to a swan-neck for attachment to the union at the top of the steam pipe on the cylinder. The whole arrangement was shown in the section of the boiler erected.

As the blower valve is the same as that specified for *Zoe* a separate drawing isn't necessary. The only difference in the whole bag of tricks is that the pipe inside the boiler is shorter, and the rawest recruit can measure the length of pipe needed from the actual boiler; $8\frac{1}{4}$ in. should do it nicely. A short piece of $\frac{1}{8}$ in. tube, with a $\frac{1}{4}$ in. × 40 union nut and cone on the end, is attached to the thoroughfare nipple. The other end is bent into a curve to come alongside the blast nozzle when the boiler is erected. This end is screwed $\frac{1}{8}$ in. or 5 BA and furnished with a jet like a midget blast nozzle, the hole in it being drilled No 70.

TURRET AND STEAM GAUGE

For the turret or steam tee, chuck a piece of $\frac{1}{4}$ in. rod, face, centre deeply, turn down 7/32 in. length to 7/32 in. dia. and screw 7/32 in. × 40. Part off at $\frac{13}{16}$ in. from the end, reverse in chuck, repeat operations, and put a No 40 drill right through. Drill a $\frac{3}{16}$ in. hole in the middle. Chuck a piece of $\frac{5}{16}$ in. rod, face, centre, drill to $\frac{3}{4}$ in. depth with No 40 drill, turn down $\frac{3}{16}$ in. length to $\frac{3}{16}$ in. dia. and screw $\frac{3}{16}$ in. × 40.

Part off at $\frac{7}{16}$ in. from shoulder, rechuck in a tapped bush held in the three-jaw, turn the outside to shape shown, and turn $\frac{1}{16}$ in. of the end to a tight fit in the hole in the double union. Squeeze it in and silver solder it.

Drill a 5/32 in. hole through the backhead flange right above the regulator gland, penetrating the water space, and tap it $\frac{3}{16}$ in. × 40. Screw the stem of the tee into this. Connect the right-hand union to the one on the blower valve by a $\frac{1}{8}$ in. pipe with union nuts and cones on each end as shown in the illustration of footplate fittings. The left-hand union is connected by a $\frac{1}{8}$ in. pipe bent into an inverted swan-neck, to a $\frac{3}{4}$ in. pressure-gauge reading to 120 lb.

Note—a steam gauge is not really essential if the safety-valve is set to blow at 80 lb. when made. The boiler will make plenty of steam and as long as the safety-valve does its job, that's all you need worry about! If the gauge isn't fitted, block the nipple with a union nut and a solid cone inside it. You may find it handy for fitting some other blob or gadget in due course.

WATER GAUGE

This type of water gauge was nicknamed George Washington in the early days of my notes because it always told the truth, which was more than could be claimed for the commercial gauges then on the market!

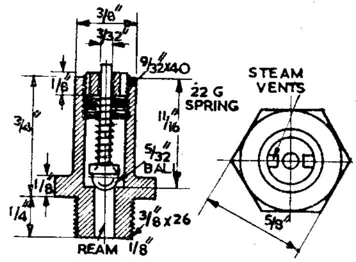
Chuck a bit of $\frac{1}{4}$ in. rod, face, centre, drill No 21 for $\frac{1}{2}$ in. depth, screw $\frac{1}{4}$ in. × 40 for 5/32 in. length, part off at $\frac{7}{16}$ in. from the end, reverse in chuck and tap the other end $\frac{3}{16}$ in. × 40 for about 5/32 in. depth. At $\frac{3}{16}$ in. from the top, drill a $\frac{3}{16}$ in. hole in the side and make a fitting to go in it just like the stem of the steam tee, but to the length shown.

Chuck a piece of $\frac{5}{16}$ in. rod, face, centre and drill to $\frac{5}{8}$ in. depth with No 40 drill. Turn down $\frac{3}{16}$ in. length to $\frac{3}{16}$ in. dia. and screw $\frac{3}{16}$ in. × 40. Part off at $\frac{7}{8}$ in. from shoulder, reverse in chuck, centre, drill No 48 until the drill breaks into the No 40 hole, open out and bottom with $\frac{3}{16}$ in. drill and D-bit to 9/32 in. depth and tap the end 7/32 in. × 40.

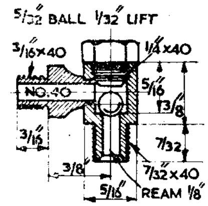
At $\frac{3}{8}$ in. from the screwed end drill a 5/32 in. hole into the central passage, and in it fit a $\frac{1}{4}$ in. × 40 nipple drilled No 40 and counterbored for $\frac{1}{8}$ in. down with No 21 drill. Directly opposite at 5/32 in. from the tapped end, drill another 5/32 in. hole and fit a $\frac{3}{16}$ in. × 40 union nipple in that one.

Silver solder all the joints at one fell swoop, then chuck a bit of $\frac{5}{16}$ in. hexagon rod, face, centre and drill No 40 for $\frac{3}{8}$ in. depth. Turn $\frac{1}{8}$ in. length to 7/32 in. dia. and screw 7/32 in. × 40. Part off at $\frac{5}{16}$ in. from the end, rechuck in a tapped bush, turn the end to a bevel and run a $\frac{1}{8}$ in. or 5 BA tap through the hole. Screw this into the tapped end of the bottom gauge fitting, and make a pin to fit by the same process as for the regulator valve but to sizes shown. The cross-handle is made from $\frac{1}{16}$ in. silver steel driven through a No 53 hole.

The top cap is turned from $\frac{1}{4}$ in. hexagon rod and needs no detailing, neither do the gland nuts, which are just like union nuts. Screw the fittings



Left: *Safety valve*



Right: *The clackbox*

into the tapped holes in the backhead with a taste of plumbers' jointing on the threads, and be sure that you get them in line.

A little judicious coaxing usually does the trick if they don't come right at first, but take care to avoid stripping the threads either on the fittings or in the soft copper. Far better to put a copper washer between the flanges and backhead. They are just right when a No 21 drill put down the upper fitting will drop straight into the counterbore in the bottom one of its own free will and accord.

A piece of glass tube $1\frac{1}{8}$ in. long and 5/32 in. dia. is needed and can be cut from a longer piece by simply nicking with a file edge, and snapping off. Rubber packing rings are made by putting a piece of rubber tube over a piece of 5/32 in. rod held in the chuck. Try a nut on it, and if the nut won't go over the rubber, ease it down with fine glasspaper while the lathe is running full speed. Then apply a wet discarded safety-razor blade to the rubber tube at 3/32 in. intervals. Push the tube off the rod—and there are your rings!

Wet the glass and a couple of rings, put the glass down the top fitting, slip on a ring, then the two nuts back to back, then another ring. Push the glass down into the counterbore, slide the nuts to the fittings (they will take the rings with them) and screw home. They need be little more than fingertight as the glass expands when hot and moves in the fittings. Screw in the top cap and the valve pin, and the job is done.

CLACKBOX OR CHECK VALVE

Chuck a piece of $\frac{5}{16}$ in. round rod, face, centre deeply with size E centre-drill, and drill No 34 for $\frac{3}{4}$ in. depth. Turn down 7/32 in. of the outside to 7/32 in. dia. and screw 7/32 in. × 40. Part off at $\frac{3}{8}$ in. from shoulder, reverse in chuck, open out to $\frac{5}{16}$ in. depth with 7/32 in. drill and D-bit, slightly countersink the end and tap $\frac{1}{4}$ in. × 40. Drill a 5/32 in. hole in the side and make a fitting for it like that in the top of the water-gauge. Silver solder it in. After cleaning up, run the tap in again, and put a $\frac{1}{8}$ in. parallel reamer through the No 34 hole.

Seat a 5/32 in. rustless steel or phosphor-bronze ball on the reamed hole. The former can be made to form its own seating by putting a piece of rod on it and giving it one sharp crack with a hammer, but a bronze one won't stand that without defacing, so use an ordinary steel cycle ball to form a seating for it. Put a nut on the threads to prevent damage while performing the seating act.

Turn the cap from $\frac{5}{16}$ in. hexagon rod, making it just long enough to allow the ball 1/32 in. lift. Bevel the end of the screwed section to give the water free access to the way out. Screw the stem of the clackbox into the hole in the middle of the backhead, taking the same precautions as before to have it vertical when screwed home tightly. The pipe connection is made after the boiler is erected.

SAFETY-VALVE

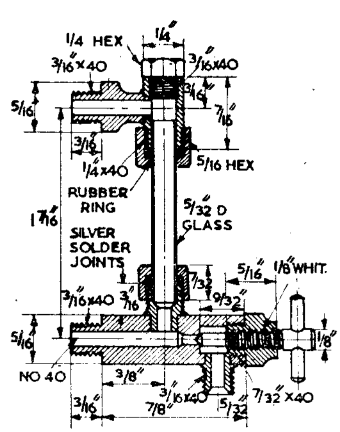
Chuck a piece of $\frac{5}{8}$ in. hexagon rod in the three-jaw, face, centre and drill No 34 for $1\frac{1}{8}$ in. depth. Turn $\frac{1}{4}$ in. length to $\frac{3}{8}$ in. dia. and screw $\frac{3}{8}$ in. × 26. Part off at $\frac{3}{4}$ in. from the shoulder, reverse and rechuck in a tapped bush, open out and bottom to $\frac{11}{16}$ in. depth with $\frac{1}{4}$ in. drill and D-bit, tap the end 9/32 in. × 40 and put a $\frac{1}{8}$ in. parallel reamer through the remains of the 34 hole. Seat a 5/32 in. ball on the hole, same as in the clackbox. Turn the outside to $\frac{3}{8}$ in. dia. as shown.

Chuck a bit of $\frac{3}{16}$ in. round rod, face the end and turn down $\frac{5}{8}$ in. length to 3/32 in. dia. Part off at 3/32 in. from the shoulder, reverse in the chuck, skim the flange to 5/32 in. dia. and slightly countersink it so that it sits fairly on the ball. Chuck a piece of $\frac{5}{16}$ in. rod, turn about $\frac{1}{4}$ in. of it to 9/32 in. dia. and screw it 9/32 in. × 40. Centre and drill No 40 for $\frac{1}{4}$ in. depth and part off a $\frac{1}{8}$ in. slice. File a nick at each side with a warding file.

The spring is wound up from 22-gauge tinned steel wire over a piece of 3/32 in. steel wire held in the chuck. The ends should be square, to press fairly on the cup flange, so wind the ends closely and touch them on the side of a fast-running emery-wheel. The spring should just start to compress when the nipple is entered into the valve column.

The plug for the bush under the dome is made from $\frac{5}{8}$ in. hexagon rod, the bottom being screwed same as the safety-valve. The boiler, with fittings attached, can then be slid into the outer casing and secured with a few 3/32 in. or 7 BA screws put through No 40 holes drilled in the edge of the casing into tapped holes in the backhead flange. As these will penetrate the water space, use brass screws, which should be a good fit in the holes, or preferably turn and screw them yourself from 5/32 in. bronze rod, and smear the threads with plumbers' jointing. Next stage, boiler erecting.

● *To be continued*



The water gauge

Catalogue received

READERS who are interested in locomotive photographs should obtain a copy of a new catalogue recently to hand from The Locomotive Publishing Company Ltd, Craven House, Hampton Court, Surrey.

The price is 2s. 0d., and some 5,000 subjects are listed, covering the period 1860 to 1930 for most English, Scottish, Welsh and Irish railways.

There is also a list of nearly 70 coloured postcards of pre-grouping locomotives and trains.

ROSE

LBSC now describes how to erect the boiler and connect up the pipes, with details of the spirit burner for firing it

Continued from 10 October 1957, pages 518 to 520

THIS simple boiler will be found easier to erect than the regular locomotive type as neither grate nor ashpan is needed, nor will expansion brackets be necessary. As both frames and boiler casing are made from the same kind of material they expand and contract together. I have found that direct attachment is quite satisfactory—and very easy!

The first job is to make up the steam pipe and blast pipe. No separate drawings of these will be required as they were shown in the illustration of the boiler erected on the frames. The steam pipe is a 1 in. length of $\frac{3}{16}$ in. copper tube with $\frac{1}{8}$ in. of $\frac{3}{16}$ in. $\times$ 40 threads on one end, and a $\frac{1}{4}$ in. $\times$ 40 union nipple on the other. This must have a hexagon base so that it can be held with a spanner while the union is tightened up otherwise the pipe will twist and probably break off.

Chuck a piece of $\frac{5}{16}$ in. hexagon rod, face, centre deeply, turn $\frac{1}{4}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. $\times$ 40. Drill No 40 to $\frac{1}{2}$ in. depth, part off at $\frac{7}{16}$ in. from the shoulder, reverse in the chuck and open out the hole to $\frac{1}{8}$ in. depth with a No 14 drill. Fit the plain end of the steam pipe into the hole and silver solder it. After the boiler has been erected it is screwed into the tapped hole in the steam chest.

The blast pipe is a $1\frac{1}{2}$ in. length of $\frac{1}{4}$ in. copper tube. Both ends are screwed $\frac{1}{4}$ in. $\times$ 40. Soften the pipe, screw it into the tapped hole in the cylinder and bend it approximately to the shape shown in the drawing. Final adjustment is made when the boiler is erected.

The nozzle is made from $\frac{5}{16}$ in. hexagon rod in the same way as a union nut, the hole being drilled 3/32 in. or No 43. Bevel off the end to a short cone and fit after erecting the boiler.

Exactly under the chimney liner drill a $\frac{5}{16}$ in. hole in the boiler shell for the blast pipe. At $\frac{3}{8}$ in. ahead of this and $\frac{7}{16}$ in. to your left when looking at the front end, drill a $\frac{1}{4}$ in. hole for the steam pipe. (The position of this is shown in the drawing of the front end in a previous instalment.) The boiler can then be placed in position between the frames, with the blast pipe going through the hole in the casing at the front end, which automatically locates it.

The back edge of the smokebox wrapper should be approximately level with the step in the top of the frame above the cylinder, but a sixteenth of an inch either way doesn't matter; it will affect neither the working nor appearance of the engine.

The correct height of the boiler bottom above the top of the frames should be $\frac{1}{8}$ in., but a fraction more or less will be of no consequence. The bottom of the firebox should be $\frac{1}{2}$ in. below the top of the frame, and the bottom of the smokebox wrapper $\frac{3}{16}$ in. below.

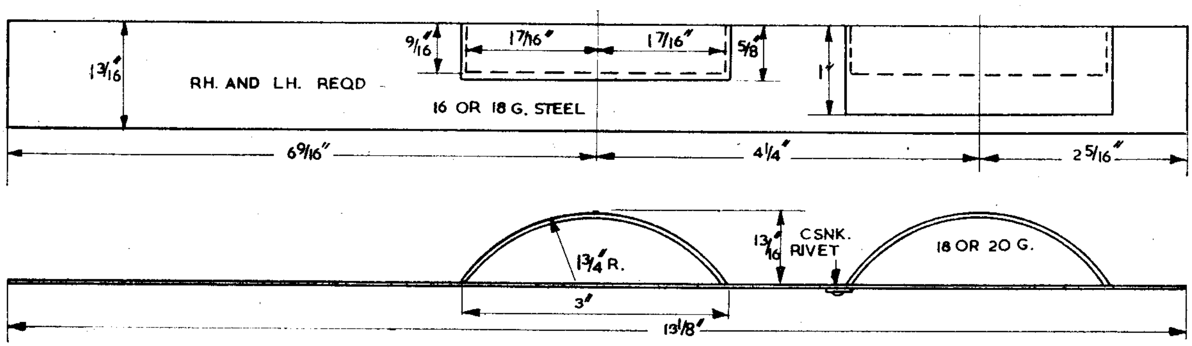
To secure the boiler in position, just drill two No 41 holes through the bottom of the smokebox wrapper and frame as shown in the drawing of the boiler erected, and two more through the side of the firebox and frame—on each side of the engine.

Countersink the holes on the outside of the frame, put 3/32 in. or 7 BA countersunk-head screws through, use ordinary nuts at the smokebox end, and pieces of 3/32 in. brass, about $\frac{1}{4}$ in. square, drilled and tapped like ordinary nuts, at the firebox end. These won't crush into the asbestos lining as ordinary little nuts would do.

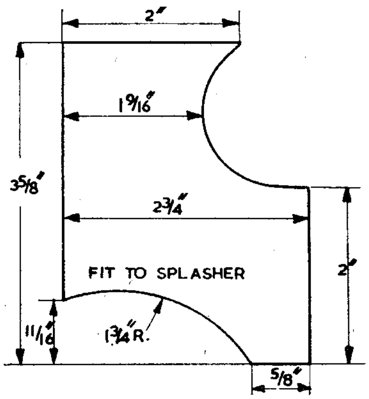
PIPE CONNECTIONS

Smear the thread on the steam pipe with plumber's jointing and screw it through the hole in the barrel into the tapped hole in the steam chest, keeping it at right angles to the cylinder. Then screw the union nut on the superheater loop on to the nipple, holding the hexagon part of the nipple with a spanner while the nut is being tightened. Screw on the blast nozzle and put a piece of 3/32 in. silver steel—this should be straight enough for the job—down the hole in the nozzle. It should stand up exactly in the middle of the chimney liner; if it doesn't carefully bend the blast pipe until it does.

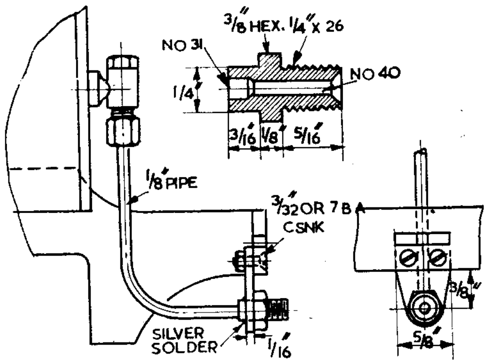
Bend the blower pipe until the little nozzle on the end lies snugly alongside the blast nozzle so that the jet steam from it will go up the liner. It should require no further fixing, the pipe being stout enough to sustain it.



The running boards and splashers



Left: *Side of the cab*



Above: *The boiler feed connections*

The interstices around the steam and blast pipes where they pass through the shell, can be sealed by wetting a few scraps of asbestos millboard, kneading them up into a kind of putty and pressing some into the cracks, leaving a little fillet around each pipe.

To feed the boiler when under steam a $\frac{1}{4}$ in. × 26 union is fitted in a bracket under the drag beam and connected by a $\frac{1}{8}$ in. pipe and union to the clackbox on the backhead. This is located in the middle of the beam, under the drawbar slot, so that the movement of the tender pipe will be the minimum possible on curves.

To make the union chuck a piece of $\frac{3}{8}$ in. hexagon rod, face the end and turn $\frac{3}{16}$ in. length to $\frac{1}{4}$ in. dia. Part off at $\frac{5}{8}$ in. from the end, reverse in the chuck, turn $\frac{5}{16}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. × 26. The coarser thread is easier and quicker to couple up than $\frac{1}{4}$ in. × 40 and lasts longer as the union has to be coupled up every time the engine is put in steam.

The finer thread is better for fittings which are "static." Centre the end deeply with a size E centre drill and put a No 40 drill right through. Reverse again, and open out the hole to $\frac{1}{8}$ in. depth with a No 31 drill.

A tip to beginners: don't drill through and open out at the first turning operation to save the second reverse as the centre drill will chatter when you try to form the countersink with it, and the union won't screw up watertight.

The bracket is cut from 16-gauge steel to the dimensions shown, and a $\frac{1}{4}$ in. hole drilled in the taper part. Fit the plain end of the union into this, then put a $3\frac{1}{4}$ in. length of $\frac{1}{8}$ in. copper tube in it, and a union nut and cone on the other end for connection to the boiler clack.

Silver solder the union into the bracket, the pipe into the union and the cone on the other end, at one heating, softening the pipe at the same time. Pickle, wash off, clean up, bend the pipe to shape and attach the bracket to the inner side of the drag beam by two 3/32 in. or 7 BA countersunk screws nutted as shown.

With this "one-piece" construction there is no risk of the union shifting in the bracket when coupling or uncoupling.

FIRING ARRANGEMENTS

The boiler is fired by a six-wick spirit lamp fed from a tank in the tender via a sump in which a constant level of spirit is automatically maintained; this prevents the burners flooding. The construction of the lamp should be as light as possible.

For beginners' enlightenment, if the lamp is made from heavy tubing, it overheats, the spirit boils and is blown out of the feed tubes. The flames die down and the engine loses steam until the feed tubes cool sufficiently to allow the spirit to return to the burner tubes.

The complete outfit was shown in place under the boiler in an illustration, recently published, when all dimensions were given. The wick tubes are made from the thinnest available brass tube of $\frac{3}{8}$ in. dia., six pieces being required.

Face both ends in the chuck to $1\frac{1}{2}$ in. length and turn a piece of brass rod to fit very tightly in the tubes, then part off six $\frac{1}{16}$ in. slices and press each into one end of each tube. At $\frac{1}{4}$ in. from the plugged end of four of the tubes drill a No 30 pilot hole clean through, open out with 15/64 in. drill and ream $\frac{1}{4}$ in.

That is the only way to get clean holes in the thin tubes; if you drill direct they will be polysided. The other two have a similar hole in one side only.

The feed tubes are two pieces of thin $\frac{1}{4}$ in. brass tube $3\frac{7}{8}$ in. long. At a full 1 in. from one end file a nick about $\frac{1}{16}$ in. deep with a $\frac{1}{4}$ in. round file on the opposite sides of the pipe. Repeat the process at $1\frac{1}{16}$ in. farther along and remove any burring so that the holes are left perfectly clean.

Push two of the wick tubes with the thoroughfare holes on to each feed tube, and the remaining tubes with the single holes on to the ends. Set the wick tubes at $1\frac{1}{16}$ in. centres, and see that the holes in the feed tubes are at top and bottom, as shown in the drawing previously referred to.

TUBES AND SUMP

The feed pipes are connected at the back end by a small auxiliary sump made from a piece of thin brass tube $\frac{1}{2}$ in. dia. and faced off at each end in the lathe to $1\frac{1}{4}$ in. length. Plug each end of this with a disc of 1/32 in. brass, or a thin slice parted off a piece of rod turned to fit.

Drill and ream two $\frac{1}{4}$ in. holes at $\frac{5}{8}$ in. centres in one side, and diametrically opposite—in the middle—drill another. Fit the ends of the feed tubes into the two adjacent holes, and in the odd one opposite fit a $\frac{1}{2}$ in. length of the same kind of $\frac{1}{4}$ in. tube.

See that the spacing of the wick tubes and sump are as shown in the drawing and the feed tubes parallel, with the sump at right angles to them. Then carefully silver solder all the joints, using best-grade silver solder and jeweller's borax—or Easyflo and the special flux sold for use with it. After pickling, wash thoroughly, letting the water run through the tubes and sump, then dry thoroughly by warming it.

The complete bag of tricks is supported by a bracket bent up from a strip of $\frac{3}{8}$ in. × 3/32 in. steel to fit between the frames, same as the motion bracket.

Set it right up as close to the trailing

ROSE . . .

continued

hornblocks as possible, the underside being 3/32 in. below the level of the bottom of the frames, and secure it in position by two 3/32 in. or 7 BA countersunk screws at each side, running through No 41 countersunk holes in the frames into tapped holes in the sides of the bracket.

In the middle of the bracket drill a No 40 hole and tap it $\frac{1}{8}$ in. or 5 BA. Cut a piece of $\frac{1}{8}$ in. × $\frac{3}{8}$ in. steel to $1\frac{1}{4}$ in. length and drill a No 30 hole in the middle. This forms a cleat which clips the feed tubes to the underside of the bracket as shown in the drawing, a $\frac{1}{8}$ in. or 5 BA cheese-head screw being put through the hole in the cleat (between the feed tubes) into the tapped hole in the bracket, rendering the complete lamp instantly detachable.

The wicks, which should be loose, are strands of asbestos string. The sump is kept supplied with spirit when the engine is working by a rubber tube attached to the short pipe at the back, running to a similar piece of pipe attached to the automatically-fed sump which will be fitted under the tender.

BOILER MOUNTINGS

The chimney can be turned from a casting or from a piece of $1\frac{1}{8}$ in. round rod. The casting should be chucked in the three-jaw and bored out—like boring a cylinder—to a push fit on the liner. It can then be mounted on a mandrel between centres and the outline turned either to the shape shown or any other that the builder might fancy.

Personally, I like the stovepipe chimney. I have a $2\frac{1}{2}$ in. gauge LNWR 4-4-0 of the Precursor type, and as the typical LNWR smokebox and chimney always seemed to look rather clumsy, to my way of thinking, I fitted her up with a circular smokebox on a saddle and perched a raky little stovepipe chimney on top of it. The result was startling! The "heavy" appearance of the front end disappeared entirely, and the little engine took on quite a racy look.

She *is* a racer, too. She can dash around my line at a speed which makes me wonder how she keeps on the rails, and despite the fact that the grate is less than 1 in. wide and only $2\frac{3}{4}$ in. long, the boiler steams like a witch when properly fired. Curiously enough, old LSWR and GER drivers whom I knew in days now long past always emphatically insisted that the engines with the stovepipe chimneys steamed better than those with ordinary bell tops.

Quite recently a Maunsell Q class 0-6-0 has been running with a stovepipe chimney, and every time she has passed the back of my hacienda she has been blowing off. I notice that a similar chimney has also been fitted experimentally to one of the LMS 4-6-0s, so the old drivers may have been correct!

The base of *Rose's* chimney cannot be turned. This being the case it must be carefully filed (this can be done while it is on the mandrel) and finished with emerycloth while revolving. The casting will be curved to fit the boiler, and can be bedded down by merely putting a piece of emerycloth over the boiler barrel and rubbing the chimney on it. This also applies to the dome casing.

THE DOME

To turn the sides and top of the dome chuck a piece of hard wood and rough-turn it to the size and shape of the inside of the casting. Press the dome on this without removing the wood from the chuck, then centre it with a small centre drill in the tailstock chuck. Put the back centre point in the tailstock barrel and bring it up to support the casting while you do the necessary with the turning tool, and finish with emerycloth.

The dome is held in position by a long screw with a countersunk head, running through the hole in the top of the dome into a tapped hole in the dome plug. The screw is easily made by silver soldering a little boss on the end of a $1\frac{3}{8}$ in. length of 3/32 in. rod, turning the boss to the shape of the screwhead and cutting a slot across it with a fine-tooth hacksaw.

This is quicker than turning the whole screw from a piece of $\frac{1}{4}$ in. rod, especially as you have to be careful owing to the slenderness compared with the length, but unless supported by a steady it is quite possible that the screw will break off on the last cut—though it isn't worth while rigging up the steady for a single screw.

The GER-type casing which was shown over the safety valve in the general arrangement drawing is a casting which only needs cleaning up with a file and drilling to fit over the safety-valve column. It may be dispensed with altogether if the top of the column is turned to the shape specified for *Zoe*.

It will, however, look rather lonesome as this type of safety valve invariably appears as twins, but a dummy column could easily be turned up and mounted on the boiler casing ahead of it to keep it company and preserve the correct appearance.

RUNNING BOARDS AND SPLASHERS

The running boards are cut from 16-gauge or 18-gauge mild steel to the dimensions shown. Clamp the two plates together to cut out the clearances for the coupled wheels, in the same way as the frames are cut.

The way I do it is to clamp the plates in the bench vice with the horizontal marked line just showing at the jaws, saw down each vertical line, then make another saw-cut at one end about $\frac{1}{2}$ in. inside the vertical line. The piece is then broken out with pliers, leaving a gap in which the hacksaw blade can be put on its side, and the horizontal line sawn along (the vice jaws guiding the blade) until the other vertical cut is reached, when the piece falls out. A file smooths off the saw marks in a minute or so.

The sides of the splashers can be cut from thinner steel to the size illustrated. The GER engines had polished brass edges to the splashers, and if you want yours to follow suit make the tops of the splashers from 16-gauge sheet brass and just solder them to the sides, then polish up the edges. Otherwise steel strip can be used for the splasher tops. Mild steel will take solder quite well if the surfaces to be joined are filed bright.

The splashers can be soldered to the running boards or they can be attached by little bits of strip steel bent to the shape shown and riveted to the inside of the splashers and the underside of the running board by $\frac{1}{16}$ in. rivets.

My own pet method is to build up the lot into a single unit with my oxy-acetylene blowpipe and Sifbronze, including the side of the cab and half the front, the whole assembly being attached to the tops of the buffer and drag beams by a couple of screws at each end so that it is easily removable.

The sides of the cab can be cut from 18-gauge or 20-gauge steel to the size indicated. Take care to make the radius fit exactly the top of the trailing splasher, which is wider than the driving one.

● *To be continued*

ROSE

Continued from 24 October 1957, pages 580 to 582

This week LBSC concludes the description of the cab for the beginners' simple locomotive and goes on with instructions for building an alternative coal-fired boiler

The difficulty about fitting a one-piece cab front to any locomotive with a boiler-barrel larger in diameter than the width of the firebox is that it cannot be erected without taking off the steam turret and any other fitting which may project.

To avoid this the cab front may either be divided vertically above the boiler or at the sides on a level with the widest part of the boiler barrel. The latter is the easier for *Rose*, as the cab front only extends down to the level of the trailing splashers, and only a couple of simple make-up pieces are required.

The upper part of the cab front can be cut from the same kind of material used for the cab sides, to the dimensions shown above the joint line in my drawing. The width should be about $\frac{1}{16}$ in. less than the overall width of the trailing splashers, so that the edges of these stand out just sufficiently to simulate the brass beading on the full-size GER locomotives of this type.

Mark off and drill the holes for the cab windows slightly undersize and finish with a reamer or they won't be truly circular. They can be "glazed" if desired by riveting a ring $\frac{1}{8}$ in. wide over each on the inside of the cab and putting a piece of mica or Perspex between cab and ring. Domestic pins snipped to required length make excellent rivets for jobs like this.

Rivet a piece of $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. angle down the full length of the front edge of the cab side and along the straight part of the bottom. Along the upper edge rivet a piece of angle bent from a strip of metal $\frac{1}{2}$ in. wide to the angle shown; you can do that in the bench vice. The upper part of the angle should be flush with the curve of the cab front. Next fit the cab sides to the front, with the corners flush and at right angles, and rivet the angles to the front. I do jobs like this by clamping temporarily the side to the front with a toolmaker's small cramp at top and bottom.

After adjusting drill the two centre holes and rivet with $\frac{1}{16}$ in. rivets, countersinking the holes (No 51 drill) on the front and riveting flush. Then remove the cramps, drill and countersink the top and bottom holes, and rivet up.

The cab front, with the two sides attached, can then be put in position on the engine, the back edge of the side sheets being $\frac{5}{16}$ in. from the back edge of the running board. Attach by a couple of 9 BA screws at each side, as shown in the small detail sketch.

Next fit the two make-up pieces between the lower edges of the cab front and the splasher and side of firebox. Cut a piece of thin card or stiff paper first, and fit it in the opening. Then cut a piece of metal to the same size and attach it to the angle on the cab side by two 9 BA countersunk screws as shown. If the joint is made close it will be practically invisible when painted.

The beading or edging around the curved part of the cab sides can be made from a strip of nickel bronze; even tin would do, $\frac{1}{8}$ in. wide, soldered on. Leave the back end projecting about $\frac{3}{16}$ in. and between this and the running board fit the pillar shown in the general arrangement darwing. This is just a piece of 15-gauge spoke wire with a little washer at the top and bottom. The lower end can go through a No 48 hole drilled in the running board, the upper end being soldered to the projecting piece of beading, which is rounded off to the diameter of the washer. Plated cycle spokes of various gauges can be got at any cycle shop, and these make excellent hand-rails and pillars.

ENGINE BUFFERS

The cab roof is made from a piece of brass, or tinplate, about 22-gauge, cut to the dimensions shown and bent to the same radius as the top of the cab front. Solder on the pieces of half-round wire as shown, then attach the roof to the angles on the cab sides by 9 BA screws as shown. An additional piece of $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. angle can be added at the top of the cab front for additional strength if desired.

There is no need to fit a detachable roof, as the handles on the footplate are easily accessible with the roof in position.

The buffer sockets can be turned from $\frac{5}{8}$ in. round rod, brass or steel. Chuck, face, centre, drill to 1 in. depth with a No 40 drill, open out to $\frac{1}{2}$ in. depth with a $\frac{5}{16}$ in. drill, turn $\frac{9}{16}$ in. length to $\frac{7}{16}$ in. dia. with a roundnose tool, and part off at $\frac{7}{8}$ in. from the end. Reverse in the chuck, turn $\frac{1}{4}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. $\times$ 40.

Chuck a piece of $\frac{5}{8}$ in. steel, face, centre, drill No 48 for about $\frac{3}{16}$ in. depth and tap 3/32 in. or 7 BA. Turn $\frac{3}{8}$ in. of the outside to a sliding fit in the socket with a roundnose tool, part off at a full $\frac{1}{2}$ in. from the end, reverse in the chuck and finish off the head to the profile shown.

Put a few 3/32 in. or 7 BA threads on each end of a piece of 3/32 in. silver steel $1\frac{1}{8}$ in. long, screw one end into the tapped hole in the head, wind up the spring from tinned steel wire about 19-gauge and assemble as shown, with a commercial nut on the pin. The buffers are just screwed tightly into the tapped holes in the beam.

A COAL-FIRED BOILER

As some builders of this locomotive wish to fit a coal-fired boiler drawings of a suitable one are shown—and here are some notes on its construction. It is quite simple to make, and a $2\frac{1}{2}$-pint blowlamp or equivalent air-gas blowpipe will do all the necessary brazing. In general the detailed instructions given for *Zoe's* boiler can be followed, working to the dimensions shown here, but I will briefly run through the job as there are points of difference.

The barrel and wrapper cannot be made from a single piece of tube split down and opened out as in *Zoe's* specification owing to the depth of the firebox, so it can either be made with a barrel made from $2\frac{1}{2}$ in. tube, with a separate wrapper of sheet copper, or it may be made wholly from one piece of sheet.

In the former case a piece of 18-gauge seamless copper tube will be needed for the barrel, faced off at each end to an overall length of 5 in. The wrapper needs a piece of 18-gauge sheet copper $8\frac{1}{4}$ in. long and $3\frac{1}{2}$ in. wide. Bend this to the shape and dimensions shown in the cross section. Bend up a ring $\frac{1}{2}$ in. wide from a strip of the same gauge copper, to fit in one end of the barrel. Leave $\frac{1}{4}$ in. projecting, and fix it with a few $\frac{1}{16}$ in. copper rivets. Fit the wrapper to the projection and rivet that likewise. Then in the gap underneath fit an 18-gauge throatplate; this can be flanged up over the bottom part of the backhead former, which is just the same as detailed for the water-tube boiler, but $\frac{3}{16}$ in. longer.

The shell thus assembled can be

brazed up as described for *Zoe*, starting at one bottom corner of the throatplate and working upwards, but when you reach the barrel carry on right around the joint between the barrel and wrapper, and go right on until the junction between the barrel and throatplate is reached. Then start again at the other bottom corner of the throatplate, and this time when you reach the barrel, carry on along the joint between the barrel and throatplate. Give it extra blow-up when you reach the end of the joint so that the brazing material thoroughly amalgamates with that first put on.

Beginners will find that coarse-grade silver solder will flow easier than brazing-strip with a blowlamp of the size mentioned. The job is a piece of cake with a big blowlamp or an oxy-coal-gas blowpipe, using easy-running brazing-strip. If oxy-acetylene equipment is available you can't beat my old favourite Sifbronze. Pickle, wash off and clean up, following *Zoe* instructions.

To make up a sheetmetal shell a piece of 18-gauge sheet copper, $8\frac{1}{2}$ in. $\times$ $8\frac{1}{4}$ in., will be needed. At $3\frac{1}{2}$ in. from the $8\frac{1}{4}$ in. end cut a snip $1\frac{1}{4}$ in. long on both sides. First bend the whole sheet to the shape shown in the cross section, then continue bending the 5 in. section ahead of the snips until it forms a circle $2\frac{1}{2}$ in. dia. with about $\frac{1}{4}$ in. overlap. Put about half a dozen $\frac{1}{16}$ in. copper rivets through the overlap to keep the edges close together, then fit a throatplate as previously mentioned.

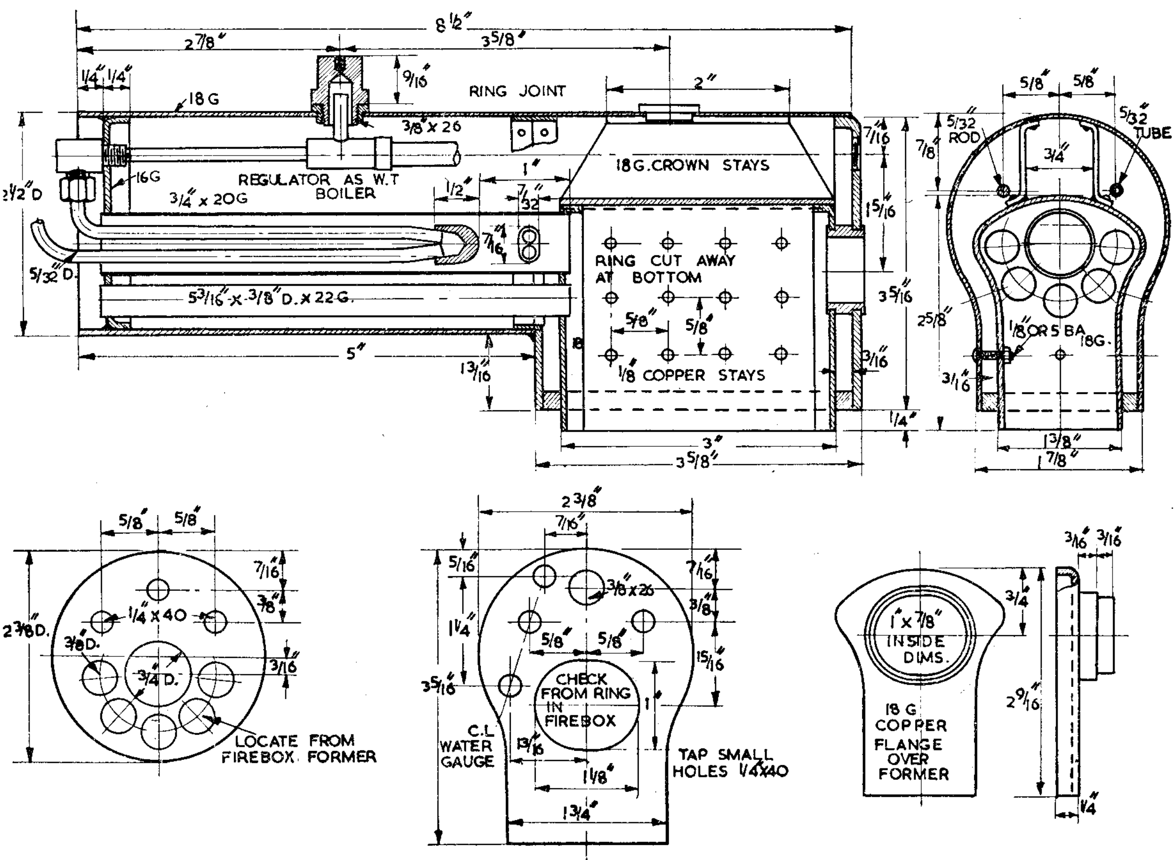
To braze the assembly, first lay the shell on its back in the pan, and, starting at the end of the barrel, go along the longitudinal seam, running in enough brazing-strip or silver solder to sweat right through the joint. Then up-end the shell and do the joint at each side of the throatplate and under the barrel, as described for *Zoe*.

After pickling, washing and cleaning up, check the dimensions, as the brazing job will have probably caused a little distortion, but judicious fettling up will soon put that right!

Cut out the firebox former from $\frac{1}{4}$ in. iron or steel to the dimensions shown, drill the holes for locating the tubes, then flange the ends of the firebox over it, using 18-gauge copper (plenty thick enough for this little boiler) and allowing $\frac{1}{4}$ in. for the flanges. To get the length of the sheet forming the sides and crown run a wire around the flange of one of the plates, then straighten it out and cut the sheet to the same length plus 3 in. width.

The holes in the tubeplate are drilled and reamed similar to *Zoe*. To make a firehole ring of the dimensions shown, a piece of copper tube $1\frac{1}{8}$ in. $\times$ $\frac{1}{8}$ in. is needed, but the exact size is of no consequence so long as you can poke a shovel into it without knocking all the black diamonds off.

Chuck the tube and turn a $\frac{1}{16}$ in. step in it $\frac{3}{16}$ in. long, part off at $\frac{9}{16}$ in. from the end, reverse in the chuck and turn a similar step on the other end. Soften the ring and squeeze it oval, then lay it on the doorplate with its centre $\frac{3}{4}$ in. from the top. Scribe a line around the flange, cut out the piece, fit the ring and bead over the flange or lip on the inner side of the doorplate.



Longitudinal section of the boiler; cross section through the firebox; the smokebox tubeplate; the backhead and firebox door plate

Bend the sheet, forming the sides and crown, to the shape as illustrated, insert the ends and secure it with a few $\frac{1}{16}$ in. rivets put through the sheet and flanges. Cut out the crown stays from 18-gauge copper and rivet them to the crown at the spacing shown. The whole assembly can then be brazed or silver soldered, using coarse grade, as previously described.

Five $\frac{3}{8}$ in. × 22-gauge tubes are required, and one $\frac{3}{4}$ in. × 20-gauge superheater flue, all $5\frac{3}{16}$ in. long. The smokebox tubeplate is flanged up over a circular former a full $2\frac{1}{4}$ in. dia. and turned to fit the barrel. The tube holes are located from the firebox former and drilled and reamed as shown, then the holes for the steam pipe and stays are drilled and tapped.

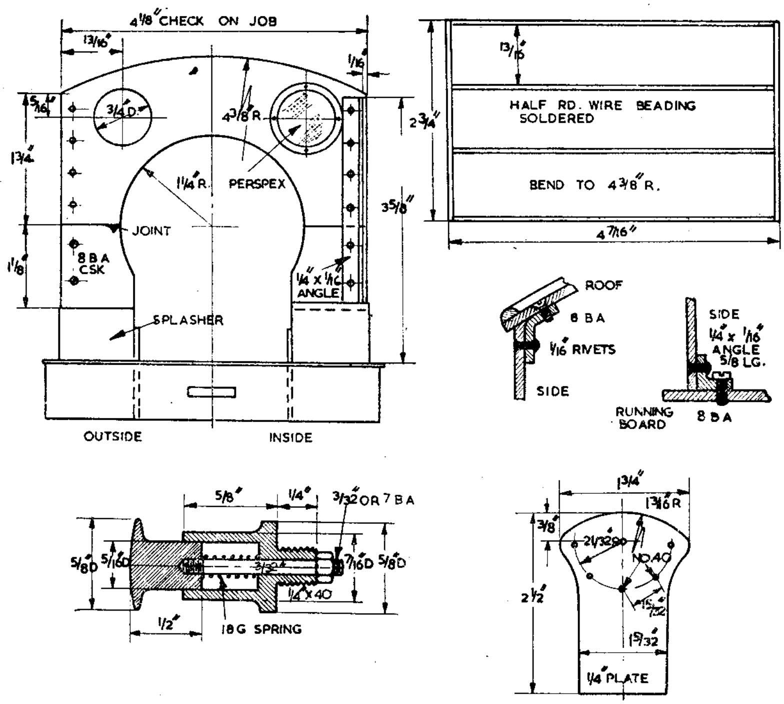
Insert the tubes in the firebox tubeplate, put the smokebox tubeplate on as the spacer and steady, line up the tubes with the sides and top of the firebox, and silver solder the lot at one fell swoop, *Zoe* instructions again.

Fit the front section of the foundation ring between the throatplate flanges, making it from $\frac{3}{16}$ in. square copper rod, then insert the firebox and tube assembly into the shell, riveting the top flanges of the crown stays to the wrapper with four $\frac{1}{16}$ in. rivets in each, and riveting through the bottom of the throatplate, piece of square rod and the firebox tubeplate. If long $\frac{1}{16}$ in. copper rivets are not available use pieces of 16-gauge copper wire.

Fit the smokebox tubeplate (flange first) in the barrel, line up the tubes and holes with a wooden skewer or pencil, and drive the tubeplate in until the tubes project a bare $\frac{1}{16}$ in. Have the tubeplate quite level, then expand the tube ends by driving something tapered, such as a drill shank, into each. If greased this will come out easily.

Beginners should use coarse-grade silver solder for the joint between the smokebox tubeplate and barrel and best grade or Easyflo for the tube ends and crownstay flanges. The job is carried out exactly as described for *Zoe*.

The backhead is flanged up from 12 or 13-gauge sheet copper just like that for the water-tube boiler, but is $\frac{3}{16}$ in. longer, and the holes for fittings are drilled as shown here. To locate the firehole measure from the top and sides of the wrapper to the flange of the firehole ring in the doorplate. Transfer the measurements to the backhead, cut the hole a little undersize and try the backhead in place, when it can immediately be seen if the hole is located correctly. If not it is an easy matter to correct it with a half-round file.



The cab front and attachments; cab roof; the engine buffer; firebox former and tube hole jig

The backhead can then be fitted with the lip of the ring through the hole, the lip being beaten outwards and downwards to clamp the backhead tightly against the ring. See that the wrapper is tight up against the backhead flange all around, then fit the remaining sections of the foundation ring, making them from $\frac{3}{16}$ in. square copper rod, and putting four $\frac{1}{16}$ in. copper rivets through each side and two at the back to hold the parts securely while doing the last brazing job.

Proceed exactly as described for *Zoe*, using coarse-grade silver solder for the job—except the flange of the firehole ring, which should be done with best grade or Easyflo.

Best-grade should also be used for the dome and safety-valve bushes, which may be made and fitted before the final brazing job, and done at the same heating. As there isn't much room for feed clacks on this small backhead fit a couple of bushes turned from $\frac{3}{8}$ in. copper rod and tapped $\frac{1}{4}$ in. × 40 at the front end of the barrel about 1 in. from the end and level with the centre line.

All the staying is done as described for *Zoe*, the blower valve, hollow stay and thoroughfare nipple being made to the drawings given for that engine, except that the length of the stay is approximately $8\frac{1}{4}$ in. to suit the length of the shorter boiler. The solid stay is of similar length and is secured by the usual kind of blind nipple at each end.

The firebox stays are made from $\frac{1}{8}$ in. copper rod screwed through both plates (firebox and wrapper) headed over on the outside and lock-nutted on the inside with thin brass nuts.

Don't forget to use plenty of cutting oil when screwing the stays and tapping the holes to get the threads as perfect as possible. Sweat over all the stayheads and nuts with soft solder, using liquid flux (not paste on any account) keeping the job hot with the blowlamp and spreading the melted solder over all the heads and nuts with a wire brush. Wash well in hot water to remove all traces of the flux, both inside and out.

The boiler can then be tested under water pressure by the method previously described, to a maximum of 160 p.s.i. Then if satisfactory fit the regulator and the superheater. The regulator valve itself, the steam pipe and the gland fitting on the backhead are all made as described for the water-tube boiler, but as steam is taken from the dome in this boiler the valve is located under the dome plug and the lengths of steam pipe and the pipe carrying the regulator rod have to be adjusted accordingly.

●*Continued on page 688*

POSTBAG . . .

tailstock side. It needs a small copper disc to prevent damage to the slide. This, also, is essential when doing a job mounted on saddle with a boring bar between centres.

(3) I made rows of holes (24 and 30) around the periphery of the back plate of the s.c. chuck. These, with a simple finger made of $\frac{1}{16}$ in. flat steel attached to the lathe bed, give an ever ready means of simple dividing for such things as castellated gland nuts, holes in eye end covers, hexagons and squares, etc.

(4) I replaced the dial on the cross slide with a larger one, $2\frac{1}{2}$ in. in my case, and divided it into 40, numbered as the enclosed sketch. These divisions now represent five thou on the *diameter* of the job in hand instead of on the *radius* as is usual. The advantage of this will, at once, be apparent. If the mike says 15 thou off, well, 15 thou it is on the dial. No mental calculations or pencil and paper required. The single thous are taken care of by the "vernier" piece attached to the back of the bearing for cross slide.

If Mr Nixon or any other reader wishes to make this "mod" and has not the facilities for doing the dividing accurately I will be only too pleased to do it for them.

Again, this idea is not original, being copied from a Swiss tool room lathe on which it appears to be standard practice.

Alnmouth, CHARLES G. S. BUIST.
Northumberland.

TWO-SPEED PLOUGHERS

SIR,—Although I took the accompanying photographs some years ago I thought they might interest readers.

The main point of interest is the two-speed ploughing gear. Two makes of engine are shown, Fowler and McLaren. The Fowler two-speed consists of twin bevel gears on the crankshaft, with meshing bevels on the upright drive to the winding drum, either of which can be brought into mesh with its fellow on the crankshaft.

The McLaren two-speed is effected with two fixed pinions on the upright drive to the drum, either of which can receive the drive from a corresponding gear sliding on the second upright shaft, which is driven from the crankshaft in the normal way.

These engines, derelict, were photographed about six or seven years ago near Ramsbury in Wiltshire.

Cirencester, PETER W. FLEXEN.
Glos.

The Fowler (extreme left) and McLaren ploughing engines. See the letter from Mr Peter Flexen

STEAM CAR

SIR,—H. Claydon [" Modern Steam Car," October 3] deserves our thanks for his experiments and for keeping alive interest in the steam car but why does he retain most of the disadvantages of the petrol car ?

By adding one cylinder only, the self starter, clutch and gearbox can be dispensed with. Using slightly larger bores, we can have the advantage of a slow revving engine and silence, and cast-iron pistons, allowing smaller clearances. Adding exhaust valves would do away with the harmful high compression of the Uniflow engine.

Water inlet valves of ample area, with small lift, would cure water hammer and save the complicated multi-plunger type; one plunger only would serve. And why use 30 watts for the blower, when a self induced draught can be satisfactory ?

I do not wish to belittle Mr Claydon's efforts but he is bypassing all the advantages of the steam car. I cannot call to mind any steam car from 1900 onwards that was not superior in most ways.

Maidstone, CHARLES E. HOOKER.
Kent.

PUZZLING FEATURES

SIR,—Mr Mansell's picture [Postbag, September 26] of the Great Orme Railway winding engine was very interesting.

Some features of this interesting little railway puzzle me; it is, of course, a cable railway, but how do the cars maintain contact with the cable when negotiating curves and loops ?

Also the line is in two sections, with the winding engine halfway up the total length of the track, necessitating changing cars to reach the top; why isn't the power-house situated at the extreme top of the line ?

As it is steam-operated, what is the purpose of the trolley-arm and overhead wire ?

Taking our thoughts to a higher and more topical "track," I was very disappointed to see that the Russians, with their artificial satellites, have beaten Michael Oxley in the realm of space flight. Perhaps he will tell us, in time for Christmas, how he has succeeded in putting rings around the Red Moon.

Thurmaston, JOHN H. DURANCE.
Leicester.

We believe Academician Oxley has finished his satellite and he is now installing the steam engine. Incidentally, his movements have taken him out of our orbit; we would like to know his whereabouts in the universe.
—EDITOR.

ROSE . . .

Continued from page 678

The actual lengths can easily be ascertained from the boiler. Instead of the three holes in the top of the regulator barrel, a No 30 hole is drilled in it exactly under the middle of the dome bush, tapped 5/32 in. × 40, and a piece of 5/32 in. pipe $\frac{1}{2}$ in. long screwed into it. A cap is turned from $\frac{5}{8}$ in. brass rod to the dimensions shown and drilled $\frac{1}{4}$ in. to fit over the pipe, thus ensuring that the steam going down the pipe is quite dry.

The union elbow at the smokebox tubeplate is the same as that specified for the water-tube boiler, but instead of a loop the usual element is fitted, with a block bend at the end as shown.

This is made from a $\frac{1}{2}$ in. length of $\frac{1}{2}$ in. × $\frac{1}{4}$ in. copper rod and drilled as shown. Braze the ends of the 5/32 in. elements into it and then file to the outline given.

The end of the lower tube is bent to a swan-neck, exactly the same as on the water-tube boiler, and furnished with a union nut and cone for connecting to the vertical pipe on the steamchest.

● *To be continued*

ROSE

LBSC now describes a suitable smokebox for the coal-fired boiler of this simple locomotive and follows on with instructions for the tender

Continued from 14 November 1957, pages 676 to 678

THE water-tube boiler did not require a separate smokebox as the casing was made long enough to include it, but this cannot be done with the coal-fired boiler, and so a separate smokebox will be needed. However, this doesn't entail much extra work—and by utilising the same arrangement as specified for the front end of the water-tube casing, the job will present no difficulties for the beginner.

The barrel of the smokebox is a piece of $2\frac{1}{2}$ in. × 18-gauge brass or steel tube faced off at each end in the lathe to a length of $1\frac{1}{2}$ in. If tube isn't available roll it from 18-gauge steel, with about $\frac{3}{16}$ in. overlap, and braze the joint, or use the same thickness in brass and silver solder it. The chimney liner is exactly the same as specified for the water-tube boiler, and is fitted in the same way, the holes for the blast pipe and steam pipe being drilled as previously described.

The wrapper is bent up from 16-gauge sheet steel or brass as on the water-tube boiler, but after fitting it to the barrel and securing it with a couple of countersunk screws at each side—at the places where it parts company with the barrel—fill up the space at the back with a piece of sheet steel or brass, bent over at each side to form flanges which are riveted to the wrapper, like the throatplate of the water-tube casing.

The upper edge is cut to fit the radius of the barrel. The front of the smokebox is a casting with a dummy door and adornments cast on (as with the water-tube front), the spigot being turned to a tight push fit in the barrel and the edge being filed to fit nicely in the recess between the barrel and the wrapper. When fitting this be sure to have it about right, for if there are any air leaks the boiler won't steam.

The smokebox is attached to the boiler by a ring which can be bent up from a $\frac{3}{8}$ in. strip of 16-gauge steel or brass. Fit this by trial-and-error, with butted (not overlapped) ends. When the ring fits very tightly in the barrel, with the ends touching, adjust it so that $\frac{3}{16}$ in. projects all around, then put four $\frac{1}{16}$ in. rivets through the barrel and ring to keep it in that position.

To fit the smokebox to the boiler, just smear some plumber's jointing around the projecting bit of ring and press it into the end of the boiler. It should need no further fixing, but if at all slack four $\frac{1}{16}$ in. countersunk screws can be put through the end of the boiler barrel and the ring. Make quite sure that the chimney liner is quite vertical before putting the screws in !

BACKHEAD FITTINGS AND ERECTION

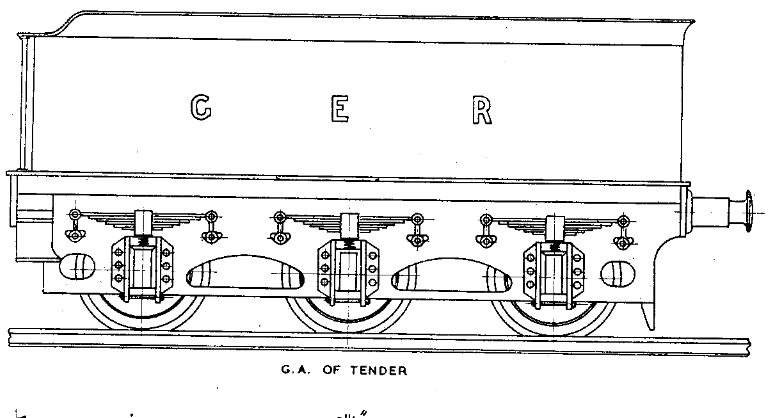
The regulator handle and blower valve are the same as on the water-tube boiler, but no feed clack is required as two of these are fitted to the bushes at the smokebox end of the barrel. Owing to the presence of a firehole door, the water gauge will have to be fitted on the slant, the upper fitting going into the hole to the left of the regulator while the lower one is fitted in the hole to the left of the firehole. Line them up as described for the water-tube boiler and fit the glass in the same way, but note that the piece of glass tube will be $\frac{3}{16}$ in. shorter.

The firehole door is made as described for *Zoe*, but oval instead of circular, which makes no difference to the fitting. It may either be cast or built up. If any builder prefers a circular firehole and door, there is no earthly reason why he shouldn't fit it; personally, I can poke a shovel more easily into an oval hole when the engine is running.

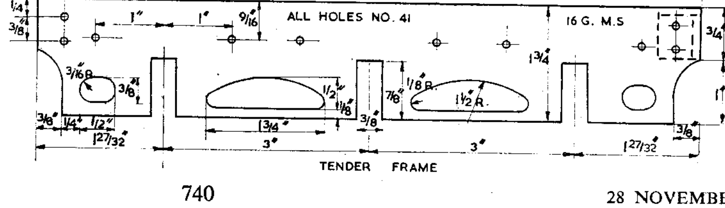
When erecting the boiler, level it up as described for the water-tube boiler and fix the smokebox end in the same way, but instead of screwing the firebox end direct to the frames, make a couple of little brackets from $\frac{1}{4}$ in. × $\frac{1}{16}$ in. brass angle, screwing them to the sides of the firebox shell about $1\frac{3}{4}$ in. from the back end so that they rest on the upper edge of the frame. Clips bent up from 18-gauge steel can be fitted as shown, to prevent the boiler lifting when the cab is off, otherwise they are not absolutely essential and can be left off.

THE TENDER

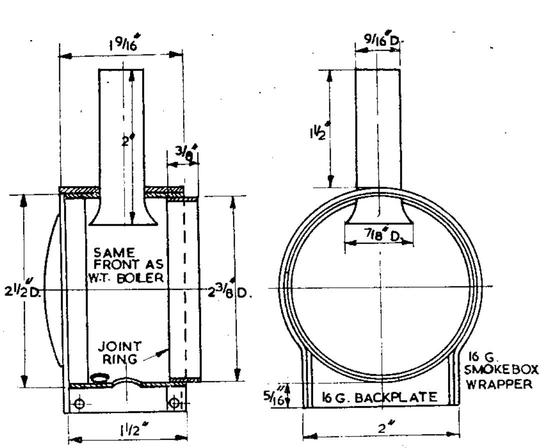
To avoid delay to the good folk who are building the locomotive with the water-tube boiler I will leave the notes on fitting the grate and ashpan until the next instalment, and carry on with the tender.



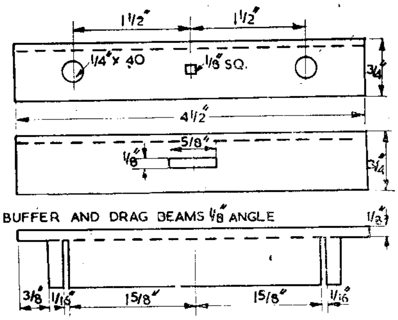
G.A. OF TENDER



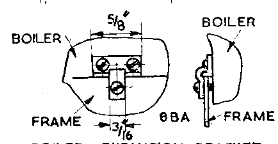
TENDER FRAME



SMOKEBOX - COALFIRED BOILER



BUFFER AND DRAG BEAMS 1/8" ANGLE



BOILER EXPANSION BRACKET

The tender illustrated is of the standard GER type as built for the engines of which *Rose* is representative, and is fairly correct both in size and in appearance. Nobody would mistake it for a tender belonging to any other railway ! It is easy enough to build, and will suit both the spirit-fired engine and the coal-fired variation by merely altering the internal arrangements as I will show.

If any builder prefers a straight-sided tank with the higher coal bunker, it can be fitted, and I will show the alternative. In any case no alteration whatever will be needed to the frames and running gear.

The frames may be cut from 16-gauge mild steel—the soft blue variety is the most suitable—or they may be cast with the dummy leaf springs and hornchecks integral as was done by two or three ME advertisers for the tender of my $2\frac{1}{2}$ in. gauge *Austere Ada*. This saves much work as the only machining needed would be cleaning out the openings for the axleboxes. A big flat file judiciously used would do that provided the frame castings were clamped together back to back.

For plate frames, two pieces $9\frac{3}{4}$ in. long and $1\frac{3}{4}$ in. wide are required. Mark out one in the usual way, drill the screwholes at each end, use it as a jig to drill similar holes in the second plate, temporarily rivet them together, and saw and file to outline. The easiest way of cutting the big holes is to drill a round hole first (anywhere in the marked-out space), then cut the outline with one of the thin spiral-tooth files, or an Abrafile, used in an ordinary hacksaw frame. As these cut in any direction the job is a piece of cake.

The buffer and drag beams can also be cast, and so will have the fixing lugs for the frames cast on. They will need no slotting; merely clean up the outer faces of the lugs and screw the frames (whether cast or plate) directly to them. Steel or brass angle of $\frac{3}{4}$ in. $\times$ $\frac{1}{8}$ in. section can be used as shown, two pieces of $4\frac{1}{2}$ in. length being needed.

The ends can be finished off dead square by putting them together, one angle inside the other, gripping in the three-jaw and facing with a round-nose tool set crosswise in the rest. The chuck will hold them all right—try it !—and it doesn't matter about the pieces running eccentrically so long as they are axially true. I used to do them like that in the days when I had no milling machine.

The faces are drilled and slotted as described for the engine, so no repetition is needed. The tops are cut away and slotted for the frames as shown. This can be done in the lathe by gripping the two pieces top-to-top in a machine vice either regular or improvised, bolted to the saddle, and running them under a $\frac{1}{16}$ in. saw-type milling cutter on an arbor between centres.

The full depth of slot can be cut in one operation if the lathe is run slowly, and plenty of cutting oil applied with a brush. The advantage is that both beams are exactly alike as to width, depth and distance apart of the slots, so that the frames when erected are at right angles to the beams and truly parallel.

When doing them on my milling machine in a similar way I put a toolmaker's cramp at each end to prevent the two beams springing apart when the cutter starts work.

I don't advise cutting the slots by hand, but if no means of machining them are available mark out the top of each beam and grip one in the bench vice with the marked-out slot just showing above the jaws. The angle will naturally have to be gripped at the end of the jaws, and, to ensure the slot being at right angles to the beam, set this vertically with a try square.

Next saw along the marked line, keeping the sawblade flat on the vice jaw which thus acts as a guide, and finish with a keycutter's warding file (or similar thin flat file) without removing the beam from the vice, using a piece of metal of the same gauge as employed for the frames as a gauge. It should fit tightly.

I have dilated on this job because if the slots are not accurately cut the whole frame assembly will be out of truth, and this, in turn, will throw everything else out, including the wheels and axles.

A $\frac{5}{8}$ in. length of $\frac{5}{8}$ in. $\times$ $\frac{1}{8}$ in. angle is riveted to the beam against the inner side of each slot, as described for the inside frames of the engine. The frames, too, are attached to them in the same way, taking the same strict caution to level up the assembly on the lathe bed, or something equally flat and true, before putting in the screws.

HORNS AND AXLEBOXES

There used to be on the market hot-pressed castings comprising a dummy leaf spring and a pair of hornchecks which were suitable for a $2\frac{1}{2}$ in. gauge tender. If these are still available I recommend their use as all they need is the rubbing faces of the cheeks cleaning up with a file to allow the axleboxes to slide easily between them. The castings are then riveted to the frames over the axlebox openings, using a piece of $\frac{3}{8}$ in. square rod to line them up, and fixing them with $\frac{1}{16}$ in. rivets in the spaces between the ribs on the hornchecks. The spring castings, being integral, required no further fixing.

Dummy leaf spring castings of the ordinary type only need a 5/32 in. hole drilled in each hoop or buckle

to accommodate a spiral spring. They can then be attached to the frames over each axlebox opening. Take care to set them centrally. Attachment is made either by drilling right through the bosses on the hangers and the frame with a No 51 drill and using long $\frac{1}{16}$ in. rivets, or putting screws through holes in the frame into tapped holes in the hanger bosses (see drawing).

The location of the holes shown in the frame drawing were taken from the cast dummy leaf springs fitted to some of my $2\frac{1}{2}$ in. gauge tenders (I still have a few castings left) but can be varied to suit any size of spring casting that the builder may have available.

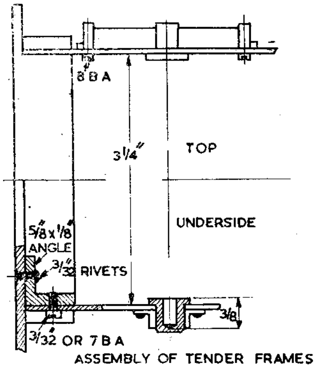
Separate cast horncheeks may be used, and will only need cleaning up on the rubbing faces. Horncheeks may also be made from 1 in. lengths of $\frac{1}{4}$ in. × $\frac{1}{16}$ in. angle as illustrated. Round off one end and drill a No 51 hole in it for the bolt-type hornstay. Bevel off the other side as shown, and drill three No 51 holes in it for the rivets holding it to the frame.

Erect with the upper-end level with the top of the axlebox opening and the rounded-off end projecting below the frame as shown in the general arrangement, using $\frac{1}{16}$ in. rivets. Put a piece of $\frac{3}{8}$ in. square rod in the opening and hold the horncheek up to it with a toolmaker's cramp over cheek and frame, while putting the first two rivets in. Cast cheeks can be attached in the same way.

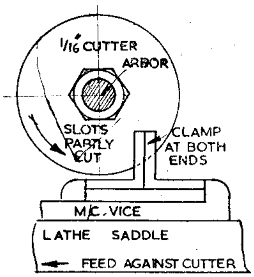
If castings aren't available for the axleboxes make them from $\frac{1}{2}$ in. × $\frac{7}{16}$ in. gunmetal or hard brass bar, a piece about $4\frac{1}{2}$ in. long being required. Mill a rebate along each shorter side as described for the engine axleboxes, clamping the piece under the slide-rest toolholder and traversing it across a $\frac{3}{8}$ in. or larger endmill or home-made slot drill in the three-jaw. If the lathe hasn't sufficient travel on the cross slide to do the whole length at one operation, cut the piece in half. After milling, either part off six $\frac{5}{8}$ in. lengths in the four-jaw or saw off the lengths to full dimension, and face them off to the correct length in the chuck.

The boxes can be made without milling by a method I described over 30 years ago. Part off six $\frac{5}{8}$ in. lengths of $\frac{3}{8}$ in. square rod for the boxes and attach the flanges made from pieces of $\frac{1}{16}$ in. sheet brass, $\frac{1}{2}$ in. wide and $\frac{5}{8}$ in. long, riveted and soldered on. I used them on my $2\frac{1}{2}$ in. gauge 4-4-0 *Simple Sally*.

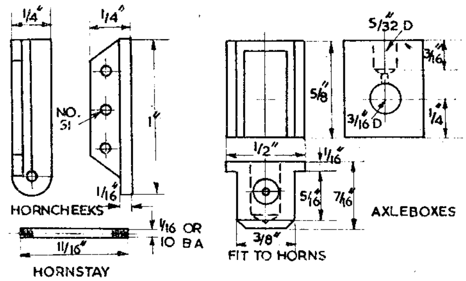
The hole for the journal is drilled $\frac{1}{4}$ in. from the bottom of each box—take great care to have it central—and put a $\frac{3}{16}$ in. drill in to $\frac{3}{8}$ in. depth (see section). On the centre line of the top of each box, at $\frac{3}{16}$ in. from the edge of the flange, drill a 5/32 in. hole $\frac{3}{16}$ in. deep for the spring, and from the bottom of this drill a $\frac{1}{16}$ in. hole through into the journal hole for oiling purposes. Thus the spring pocket also serves as an oil cup !

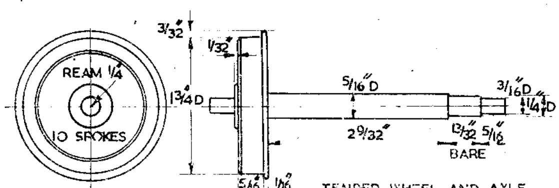


ASSEMBLY OF TENDER FRAMES



SLOTTING BEAMS





TENDER WHEEL AND AXLE

The front faces of the boxes can be bevelled off with a file as shown for appearance' sake, or can be finished off in any other fashion that may suit the builder of the engine. The springs can be wound up from 20-gauge tinned steel wire, and should just start to compress when the axleboxes are at the bottom of the slots. They can't jump out when running over a rough road, the lower part being in the pocket in the axlebox and the upper part in the hole in the hoop of the casting.

The axleboxes are prevented from falling out when the tender is lifted by hornstays made from $\frac{11}{16}$ in. lengths of $\frac{1}{16}$ in. silver steel, screwed both ends either $\frac{1}{16}$ in. or 10 BA, put through the holes at the bottom of the horncheeks and secured with commercial nuts.

Now for the easiest way to assemble and erect the whole issue: lay the frame upside down on the bench, put the springs in the holes in the hoops, with an axlebox on each journal, and drop them into place with the axleboxes between the horncheeks and then put the hornstays in and nut up. But before embarking on that enterprise the wheels and axles must be turned and fitted.

WHEELS AND AXLES

The wheels are the same size as the leading wheels of the engine—$1\frac{3}{4}$ in. dia. on the tread with 3/32 in. flanges. They are machined in exactly the same way, but the bosses only project a bare 1/32 in. from the face of the rims as they have to fit between the flanges of the axleboxes when erected.

The axles are turned from $\frac{5}{16}$ in. round mild steel, three pieces each $3\frac{3}{4}$ in. long being needed. If the three-jaw is reasonably true the journals and wheel seats can be turned at the same setting, and then they must of necessity be true with each other. If the chuck is badly out of truth turn the axles between centres. First take a skim off the end to true it up, then turn $\frac{5}{16}$ in. length to $\frac{3}{16}$ in. dia. an easy fit for the hole in the axlebox, which can be used as a gauge. Turn the next 13/32 in. (bare) to a press fit in the wheel boss.

Now I certainly don't advocate turning wheel seats taper. The smallest amount of side movement that develops would loosen the whole lot. Fit them just as I describe fitting the combining cone of an injector. With a $\frac{1}{4}$ in. taper broach take a very tiny scrape out of the end of the reamed hole in the boss of the wheel, entering the broach from the back. The scrape shouldn't exceed $\frac{1}{8}$ in. in depth. Turn the wheel seat so that it just—*and only just*—enters the scraped end of the hole. It should then be a perfect press fit in the unscraped part of the hole.

●*Continued on page 752*

what the terms relating to power and performance mean. There are many misconceptions on this matter . . ."

May I clear up some which appear in the next paragraph of his article?

"Force" is quite literally "push" or "pull." "Weight" is, itself, a force—the force on a body due to gravity. The unit in which force is measured is the lb. wt (loosely referred to as the pound).

The "foot-pound" (strictly foot-pound-weight) is the unit of "work" or "energy."

"Work" is defined as force multiplied by the distance through which the force moves or, for a rotating shaft, torque × angle through which the shaft turns.

"Power" is the rate of doing work (or rate of using energy) or simply

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$ and is, thus, measured in ft-lb. wt/min. or horse-power as stated.

"Energy" is not an equation of force—time or anything else. It can most simply be defined as "stored work."

Perhaps, in closing, I may say that I enjoy E.T.W.'s articles more than any others in MODEL ENGINEER. Good luck to the present series.

CRANK.

PICKERING GOVERNOR

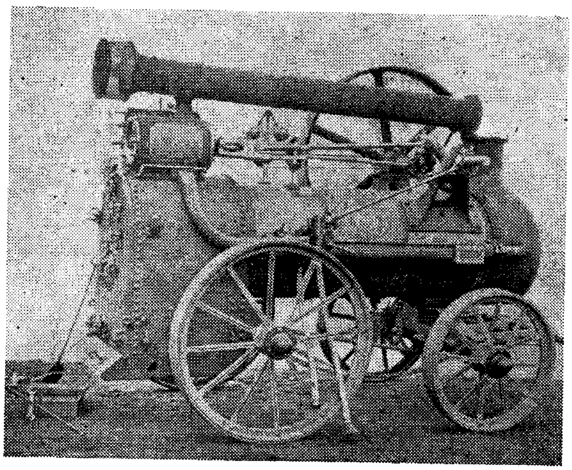
SIR,—There seems an awful lot of talk lately about Mr W. J. Hughes' Pickering governor, and it is some time now since I saw one. It may surprise Mr Hughes and, perhaps, many other readers likewise that some years ago Messrs. Pat Collins and Co., the well-known fairground operators, used one of these governors on a diesel engine—I think it was either a Leyland or a Fowler-Saunders—set up on a generator set on a trailer.

I am not mistaken at all in this statement as I was deputed to watch these diesels start up and I remember so well seeing this Pickering governor driven by belt from the engine shaft.

I wonder if our very good friend Mr. Hughes is in possession of *Machine Drawing Book I*, by Messrs T. and T. G. Jones (1920). On plate 57 he will find a beautiful Pickering Governor.

Incidentally, can anyone tell me what became of the firm of Armstrong Saurer of Newcastle upon Tyne? They made a very fine vehicle once upon a time!

Cefn Mawr, Denbs. COLIN B. WHITEHALL.



What do the experts know of this portable engine whose picture was discovered in an old album by Thomas Nelson, of Surrey

OLD PORTABLE ENGINE

SIR,—I came across the enclosed photograph in an old album in Warminster, Wilts. I thought it might be of some interest to experts on old portable engines. It is such a very good photograph for its period.

Haslemere, Surrey. THOMAS NELSON.

USING A CLEANER

SIR,—I would like to reply to a couple of criticisms of my use of a vacuum cleaner for a gas blowpipe. One is in reply to M. G. D. Skelding [Postbag, October 24].

I always remove the endcap and dustbag before using the machine and I have a proper gas blowpipe with air and gas taps.

I turn on the gas, keeping the air supply closed, light up, switch on the blower then turn on the air. I claim this is perfectly safe.

The other criticism—that cleaners are short rated and liable to burn out [J. W. Cooper, Postbag, September 19]—well the machine I use (Vactric) does not get any hotter than usual, although I have had it in use for over an hour.

All the air used passes through the motor and helps to cool it. After all, all electric tools can overheat and burn out if used without care and common sense.

Only a few weeks ago I saw a *continuous rated* mains motor burn out through being over-worked.

Birmingham 26. E. F. GOUGH.

SIR,—M. G. D. Skelding's letter about the gas explosion reminds me of an episode which took place in a small factory where I worked during the war.

A gas blowpipe with the bypass always alight was connected up to the works air supply by way of the original treadle bellows. One of the trainees, a Home Guard captain, dismantled a mills bomb and burned some of the powder on a brick by the blowpipe.

Two days later there was a shattering explosion which brought the boss running from his office. The captain was accused by everyone of endangering our lives and was duly sacked, though he strongly maintained his innocence.

We all settled down to work again confident that the works were then a safer place, but a week later there was another bang, from the forge this time, blowing the bellows inside out.

As there was no one left to blame we correctly diagnosed the cause to a certain amount of gas from the bypass gradually filling the bellows via the air pipe until the correct explosive mixture was reached for the flame to ignite.

Beaumaris, Anglesey. H. A. JONES.

ROSE . . .

continued from page 742

Reverse the axle and repeat the operation on the other end, making the distance between shoulders of wheel seats 2 9/32 in., then press on the wheels using the vice as a press. Put a piece of soft metal between the end of the axle and the vice jaw, and a bush between the jaw and wheel at the other end to allow the axle to come through the wheel. Spin each pair between temporary bearings to check for truth before erecting in the frames.

● *To be continued*

ROSE

In this instalment LBSC describes the tender arrangements for the locomotive with the spirit-fired boiler and gives variations for the coal-fired version

Continued from 28 November 1957, pages 740 to 742

ALTHOUGH there is considerable difference in the internal arrangements of a tender for a spirit-fired locomotive, and one with a coal-fired boiler, both are used with the same tender body. It will save time and space if I deal with them both together.

The back corners of the tenders supplied to the GER mixed-traffic engines were square, not rounded like certain other types, and the corners of the flared coping were mitred. Therefore, it will be easiest to build the tender body as a three-piece job, two sides and a back, forming the sections of coping in one piece with each plate.

First fit the soleplate to the chassis. This is a piece of 16-gauge sheet brass 10 in. long and $4\frac{5}{8}$ in. wide. Make sure it is truly rectangular by testing each end with a try-square. Set it on the chassis so that the overlapping at each end and side is the same, then attach it to the tops of the beams by two 3/32 in. countersunk brass screws at each end. Drill No 41 clearing holes through the soleplate and beam tops, and put nuts on the screws underneath the beams. This allows the complete body to be removed from the chassis at any time if required by simply removing the nuts.

Bending the copings

Each side sheet will need a piece of 20-gauge sheet brass (hard-rolled is best if obtainable, as this is dead flat) $9\frac{3}{4}$ in. long and $2\frac{5}{8}$ in. wide. Cut one of the long sides at one end to form the curved part of the front end of the coping, then cut away $\frac{1}{4}$ in. of the other end leaving the overhanging part of the coping as shown.

Before I had a bending machine I formed my copings by gripping the edge to be bent between two pieces of round rod a little longer than the tender side, and putting the lot between the jaws of the bench vice, with the rods level with the top. With the aid of a piece of wood about $1\frac{1}{2}$ in. square, and longer than the rods, the projecting sheet of metal was forced down at right angles to the part gripped between the rods, and a nice even coping was the result.

The back requires a piece of 20-gauge sheet brass $4\frac{5}{8}$ in. $\times$ $2\frac{5}{8}$ in. Cut away $\frac{1}{4}$ in. of both ends leaving the curves at the top as shown, then bend as described for the sides. The dimensions given in the drawings show the approximate height of the sides and back after the copings are formed.

Next rivet on the pieces of angle to which the removable tank top is attached. These are $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. section, 6 in. long, and they are fixed to the sides at $2\frac{1}{16}$ in. from the bottom. A similar piece is riveted along the back. Use $\frac{1}{16}$ in. brass or copper rivets.

On this small tender there is no need to rivet angles along the full length of the lower edges; if a piece about 1 in. long is attached at each end, and a similar piece about midway along the side, it will be plenty strong enough. The end and sides can be joined by riveting a piece of angle in each corner, as with the cab.

To attach the sides and back (thus far assembled) to the soleplate, drill a No 43 hole in each bottom angle, set the assembly on the soleplate with the back $\frac{1}{8}$ in. from the edge, and the sides $\frac{1}{4}$ in. from each edge. Tack the lot in place with a little blob of soft solder at each angle, then put the No 43 drill through the holes in the angles, making countersinks on the soleplate. Follow with a No 50 drill, tap 8 BA and put in brass screws of any shape head. Finally solder all round the bottom on the inside, and over the angles at the corners, to make the lot watertight.

COMPARTMENT FOR SPIRIT

First fit the division plate which separates the spirit and water sections. This is a piece of 20-gauge brass $2\frac{1}{8}$ in. wide and just long enough to fit nicely between the sides of the body. Rivet a piece of angle at $\frac{1}{16}$ in. from the top, and another piece along the bottom. The top piece must be cut to fit between the angles attached to the sides.

The plate is then put in the postion shown, butting up against the front ends of the side angles and soldered along the bottom and up the sides. A couple of 8 BA brass screws can be put through the bottom angles into the soleplate for extra strength, and soldered over.

The front plate of the spirit compartment is just a piece of 20-gauge brass $2\frac{1}{16}$ in. $\times$ $4\frac{1}{2}$ in. Bend over about $\frac{3}{16}$ in. of each end to a right angle, so that the plate fits between the tender sides, then set it in place $\frac{3}{8}$ in. from the front edges and square with the sides. Solder it in place, no rivets are necessary, as there is neither heat nor pressure to resist.

The top cover is a fixture. Cut a piece of 20-gauge brass approximately $3\frac{1}{8}$ in. $\times$ 4 in. full, to cover the top of the compartment. This should fit exactly between the tender sides, butting up against the top edge of the division plate and resting on top of the front plate.

Before fixing it, drill a $\frac{1}{4}$ in. hole on the centre line, $\frac{5}{8}$ in. from the front edge, and another at $1\frac{1}{4}$ in. behind it. Fit the plate in place and solder it all round, making sure that no places are missed and the joints are absolutely tight. If there are any air leaks it is goodbye to the automatic action of the spirit feed.

Put a $\frac{1}{4}$ in. drill down the rearmost hole and carry on right through the soleplate. Open out the upper hole to $\frac{3}{8}$ in. and the hole in the soleplate to $\frac{5}{16}$ in. clearing. At $\frac{3}{4}$ in. behind this drill a $\frac{3}{8}$ in. hole for the air pipe. This is a $3\frac{1}{4}$ in. length of $\frac{3}{8}$ in. copper or brass tube bevelled off at one end as shown, pushed through the hole in the soleplate so that the upper edge of the bevel is 1 in. from the soleplate, and soldered in position.

SPIRIT VALVE AND AIR PIPE

To make the spirit valve, chuck a piece of $\frac{3}{8}$ in. hexagon rod, face, centre and drill to $\frac{7}{8}$ in. depth with 3/32 in. drill. Open out and bottom to $\frac{1}{2}$ in. depth with 7/32 in. drill and D-bit, then tap the end $\frac{1}{4}$ in. $\times$ 40. Turn $\frac{1}{2}$ in. of the outside to $\frac{5}{16}$ in. dia. and part off at $\frac{1}{4}$ in. from the shoulder. Reverse in chuck, turn to contour shown, and file a 3/32 in. slot at each side just above the shoulder, see section.

Chuck a piece of $\frac{5}{16}$ in. rod, face, centre and drill No 31 for $\frac{7}{16}$ in. depth. Turn $\frac{3}{16}$ in. to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. $\times$ 40. Part off at $\frac{3}{16}$ in. from the shoulder, rechuck and put a 5/32 in. $\times$ 32 tap through the hole. Screw the piece into the body of the valve.

Chuck a piece of $\frac{1}{2}$ in. rod, face, centre and drill No 21 for $\frac{1}{2}$ in. depth. Turn $\frac{3}{8}$ in. length to $\frac{3}{8}$ in. dia. and part off at $\frac{1}{16}$ in. from shoulder. Reverse

in the chuck, open out to $\frac{5}{16}$ in. depth with a 7/32 in. drill and tap $\frac{1}{4}$ in. × 40. Make a gland to suit, from $\frac{3}{8}$ in. hexagon rod.

The pin is a $2\frac{3}{4}$ in. length of 5/32 in. rustless steel or bronze. Turn one end to a blunt cone point, screw 5/32 in. × 32 for a full $\frac{3}{4}$ in. and turn the first few threads away. Cross-drill the other end No 43 and fit a piece of 3/32 in. silver steel in it. Any length will do, but round off the ends.

Push the valve body through the hole in the soleplate from underneath, and fit the gland in the upper hole, soldering them both; insert the pin and pack the gland with graphited yarn. Open the other hole in the tank top to $\frac{5}{16}$ in. and solder a $\frac{1}{4}$ in. × 40 tapped bush in it, made from $\frac{3}{8}$ in. rod. The screwed plug is turned from $\frac{3}{8}$ in. hexagon rod and needs no detailing. Put a 1/64 in. Hallite washer between head and bush.

SPIRIT SUMP

The sump is merely a rectangular tank measuring $1\frac{3}{4}$ in. × $\frac{3}{4}$ in. and $1\frac{15}{16}$ in. deep, made from 22-gauge metal in the same way as I have described for mechanical lubricator tanks. At $\frac{3}{16}$ in. from the bottom of one of the narrow sides, drill a $\frac{1}{4}$ in. hole and solder a $1\frac{1}{2}$ in. length of $\frac{1}{4}$ in. tube into it. Solder a piece of $\frac{1}{4}$ in. × $\frac{1}{16}$ in. angle along each side, level with the upper edge, and file a small slot in the upper edge of one end to serve as an air vent.

The sump is attached to the underside of the soleplate by two 8 BA screws at each side—put through No 43 clearing holes drilled in the angle—into tapped holes in the soleplate. It should be located centrally, with the front end about $\frac{1}{8}$ in. behind the leading axle.

TENDER PUMP

The pump is one of my "standard" type operated by an extension handle through the filling hole in the top of the tank, and as I have only recently described a similar one in detail for testing *Zoe's* boiler it is a waste of space to repeat the whole ritual. Just follow the instructions already given, but work to the sizes shown in the drawing reproduced here, where they differ from those in the pump mentioned.

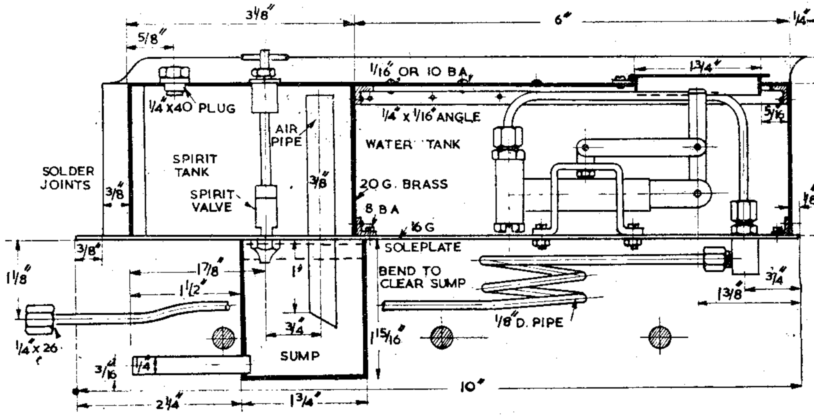
There is one difference in the valve box, as the outlet is on top instead of at the side, so instead of fitting the separate cap and nipple, fit the union cap shown.

Chuck a piece of $\frac{3}{8}$ in. hexagon rod in the three-jaw, face, centre deeply and drill to $\frac{5}{8}$ in. depth with a 3/32 in. drill. Turn $\frac{1}{4}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. × 40. Part off at $\frac{1}{4}$ in. from the shoulder, reverse and rechuck in a tapped bush, and turn down 5/32 in. length to $\frac{1}{4}$ in. dia., screwing $\frac{1}{4}$ in. × 40. Cross-nick the end and assemble as shown.

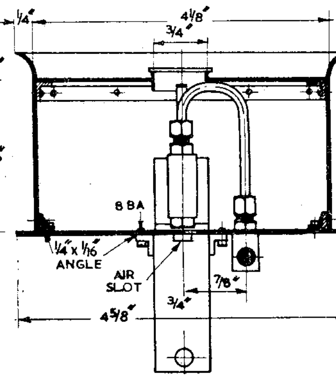
Set the pump lever vertically, then erect the pump in the tank with the centre of the lever $1\frac{3}{8}$ in. from the back, fixing the lugs to the soleplate by $\frac{1}{8}$ in. or 5 BA brass screws. Drill No 30 holes through both lugs and soleplate, and fit nuts to the screws as shown.

At $\frac{7}{8}$ in. to the left of the centre line and $\frac{3}{4}$ in. from the back of the soleplate, drill a $\frac{1}{4}$ in. hole and fit a union elbow in it. To make this, chuck a piece of $\frac{3}{8}$ in. round rod, face, centre deeply, and drill No 40 for $\frac{3}{4}$ in. depth. Turn $\frac{3}{8}$ in. length to $\frac{1}{4}$ in. dia., screw $\frac{1}{4}$ in. × 40 and part off at $\frac{1}{2}$ in. from the shoulder. At $\frac{3}{16}$ in. from the blind end drill a 5/32 in. hole breaking into the centre hole, and silver solder a $\frac{1}{4}$ in. × 40

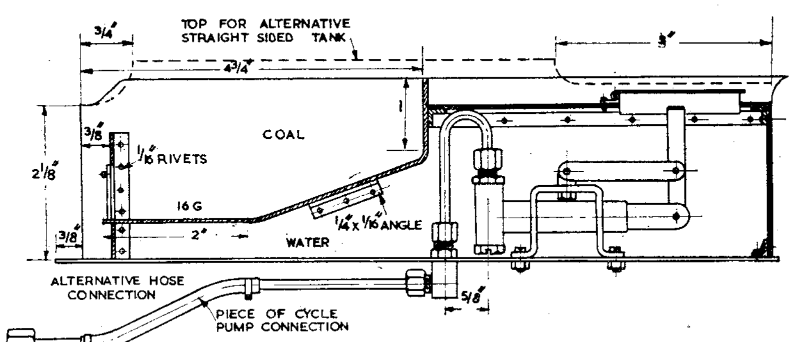
Sections through the two types of tender; the upper, the spirit-fired version; the lower, the coal-fired



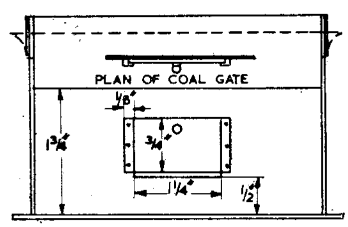
TENDER FOR SPIRIT-FIRING



SECTION THRO TANK



SECTION OF TENDER COAL FIRING



FRONT VIEW OF TENDER

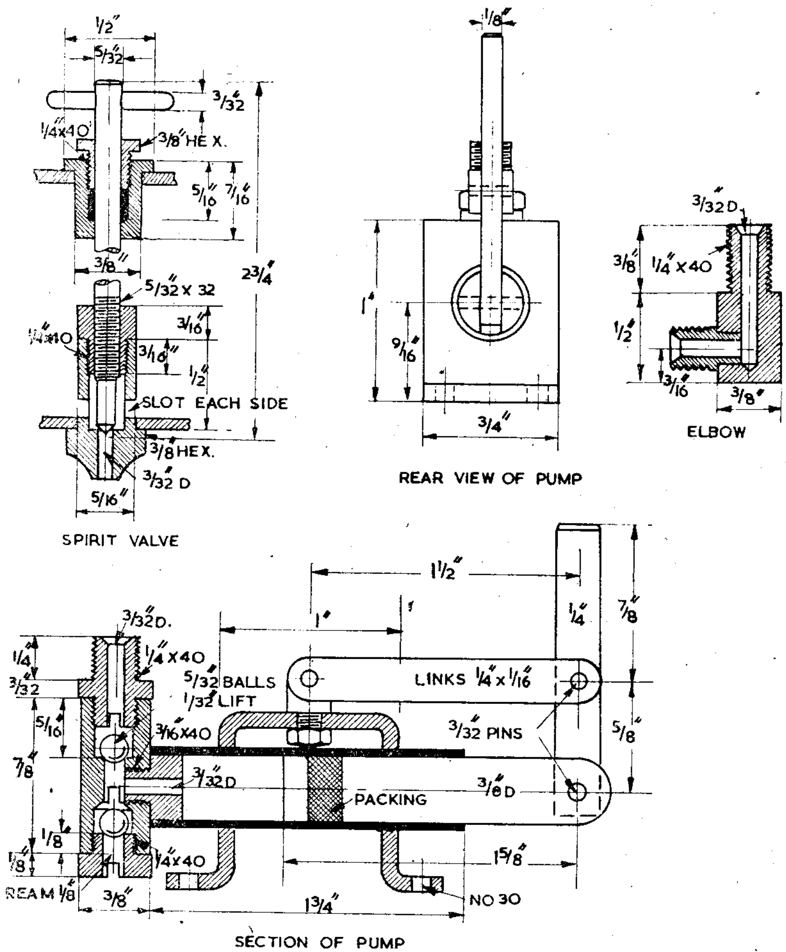
union nipple in it. Push up the screwed end through the hole in the soleplate, and secure it with a $\frac{1}{4}$ in. × 40 locknut made from $\frac{3}{8}$ in. hexagon rod.

Connect the union on top of the valve box to the union on the elbow by a piece of $\frac{1}{8}$ in. thin-walled tube with a union nut and cone at each end. The pipe connecting the outlet underneath with the union on the engine must be flexible, or the whole lot will come off the road on curves in the line.

To get the length of this, bend a piece of wire into a spiral about $1\frac{1}{2}$ in. dia. with two complete turns as shown, hold it under the soleplate between the middle and trailing axles, cut one end level with the nipple on the elbow union and the other $\frac{3}{4}$ in. ahead of the front beam. Straighten out the wire, cut a piece of $\frac{1}{8}$ in. thin-walled pipe to the same length, fit a $\frac{1}{4}$ in. × 40 union nut and cone on one end and a $\frac{1}{4}$ in. × 26 ditto on the other.

When silver soldering on the cones, make the whole length of pipe red hot and quench the lot in the pickle. Wash well in running water, rub up the pipe with a handful of steel wool, and you can then wind the spiral with your fingers around the domestic broom handle without any fear of kinking it. I keep a short length handy for jobs like this!

Don't forget to bend the spiral with the $\frac{1}{4}$ in. × 40 union nut at the shorter end of the pipe; connect this to the elbow union and bend the other end so that it comes centrally and lines up with the union on the engine.



From left to right, top drawings: Part section through water tank; spirit valve; back view of pump; elbow union. Lower drawings: Front end of tender for coal firing; section of tender pump

REMOVABLE TANK COVER

Cut a piece of 20-gauge brass to cover the top of the tank. This should be approximately 6 in. long and a full 4 in. wide. At one end, starting at $\frac{5}{16}$ in. from the edge, cut a hole $1\frac{3}{4}$ in. long and $\frac{3}{4}$ in. wide with rounded corners. Bend a $\frac{1}{4}$ in. strip of brass to same shape and solder it in with $\frac{1}{8}$ in. showing at the top. Have the joint in front.

Cut another piece of brass just big enough to overlap the opening and form a lid, but leave two tags $\frac{1}{8}$ in. wide and about $\frac{5}{16}$ in. long at one end. Bend these into loops with a pair of roundnose pliers. Cut another short strip to fit between them and bend that into a loop at the end. Put a short piece of $\frac{1}{16}$ in. wire through the loops to form the hinge, then attach the strip to the tank top by a small screw as shown. The tank top can then be attached to the angles all round by $\frac{1}{16}$ in. or 10 BA brass screws, roundhead for preference—put through clearing holes in the plate—into tapped holes in the angles at about 1 in. spacing.

A beading of half-round wire can be soldered all round the edge of the coping to give a finishing touch to the job, the front ends being extended and bent around a piece of 3/32 in. silver steel screwed into the soleplate to form a handrail pillar. See general arrangement drawing.

VARIATION FOR COAL FIRING

The sides and back of a tender for the coal-fired version of *Rose* are made and fitted in the same way as I have just described. If a modern straight-sided tender is fancied, leave out the coping and cut the sides as shown by dotted lines. If a piece of metal sufficiently long is available, I recommend making the sides and back in one piece with bent corners, which saves joining separate pieces.

The pieces of angle for supporting the removable tank cover are only $4\frac{5}{8}$ in. long, but are fitted in the same way; so is the back section. The front plate is made and fitted as before, but is only $1\frac{3}{4}$ in. high, and has an opening $1\frac{1}{4}$ in. × $\frac{3}{4}$ in. cut at $\frac{1}{2}$ in. from the bottom. A runner is riveted at each side of this to carry the coal gate, see front end view.

The coal plate is made from a piece of 18-gauge or 20-gauge brass $5\frac{3}{4}$ in. long and just wide enough to fit nicely between the sides of the tender. Cut away $\frac{3}{16}$ in. at each side of one end, leaving a $1\frac{1}{4}$ in. tongue in the middle, then bend the plate to the shape shown in the section. Try it in place and mark on each side of the tender the location of the two small pieces of supporting angle shown. On the back of the vertical part of the plate scribe a line level with the side angles.

Contined on page 814

out here with me; and it has been worth its weight in gold.

Model engineering tools and supplies are becoming easier to obtain now as the place develops, but it still leaves a lot to be made in the home workshop. Castings are practically unobtainable, so is small hexagon steel or brass rod. However, shortages of this kind really only encourage initiative on the part of the model engineer.

At present I am building a vertical slide for my Grayson lathe, a free-lance job, but it should prove very useful.

I must congratulate you on the way you keep up such a high standard in MODEL ENGINEER, with plenty of steam work in evidence and good old LBSC.

Townsville, Queensland. JOHN W. OSGOOD.

ANY OTHER BUSINESS

SIR,—With *Zoe* approaching completion, thought is doubtless being given to LBSC's next series. I would like to suggest that a few items of unfinished business be taken care of first. For example, in 1932-33 LBSC described a LNWR 2-4-0 *Sister Dora*. As described, a Joy valve gear was used, but in the course of the series, LBSC made some mention of scheming out an Allan straight link. Has this ever been published? If not, why not now?

A couple of years ago, LBSC stated that he could give a satisfactory boiler for *Puffing Billy*. This has not appeared. I think this would be interesting.

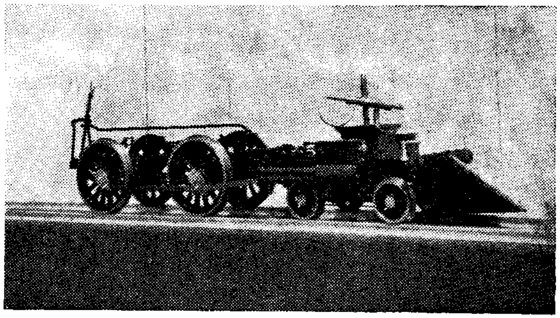
For the next engine, I would like to suggest the following for consideration: Mallet—the N and W *Anabelle* which LBSC has built; Garratt—East African Railways 59 class, built to $\frac{3}{4}$ in. scale for $2\frac{1}{2}$ in. gauge; and a Midland compound 4-4-0 for $3\frac{1}{2}$ in. gauge.

E.W.W. [Readers' Queries, July 4] asks for information on a reversing valve gear for Sir Morris de Cowley.

If he will refer to *English Mechanics* (now a Percival Marshall publication) for 11 and 18 September 1931, he will find that LBSC has given a Baker gear for *Small Bass*. I recall that he also described a Stephenson link for *Small Bass*, but cannot recall the issue. I believe that it used a simple round pin for the die block, a construction which, in more recent years, LBSC has found unsatisfactory.

Pennsylvania, USA. FRANK H. MOORE.

SIX MONTHS' LABOUR



The stage that Mr Jack Kulish has reached after six months' work on LBSC's VIRGINIA

SIR,—My snapshot shows six months' work on LBSC's *Virginia* in 1 in. scale. I made the patterns and did all the castings. Wheels and cylinders are cast iron; drivers are 5 in. dia. and cylinders $1\frac{3}{8}$ in. × $1\frac{7}{8}$ in.

Stanford, Mont., USA. JACK KULISH.

STEAM CARS

SIR,—In the series of articles on steam cars I am surprised to find that the basic specification for a road vehicle has never been stated.

Assuming what is required is a small family car, the equivalent of the Austin A35 or Morris Minor 1000, this should be as follows: unladen weight not exceeding one ton; high rate of acceleration from standing start to prevent obstructing other traffic and to back out of trouble in traffic; maximum speed limited to 50 m.p.h.; instantaneous response to the throttle; and fuel consumption cost equivalent to not more than 50 m.p.g. at premium grade petrol prices.

Of these conditions what does the steam engine comply?

The flat power curve, almost constant torque over speed range, will give high acceleration with a limited top speed.

Flash boilers are out because they cannot answer the throttle without a dangerous time lag. As they contain very little water and no steam storage space the throttle must control the fuel, air and water feed with the engine having no separate steam control. This means that, with the very wide difference in fuel flow rate between idling and full power, the vaporising burner must be replaced by an atomiser more on the lines of a conventional i.c. carburettor bit with controlled fuel feed.

For economy the firebox must be pressurised, and as for starting from cold, the water, air and fuel feed unit must be an auxilliary electrical unit. Now there comes a glimmer of light of the path on which steam prime mover may have a faint chance of success.

I suggest a constant speed De-Laval type turbine, direct coupled to a d.c.

ROSE . . . *continued from page 806*

Remove the plate and rivet a piece of angle to the back of it flush with the marked line, but stopping short at $\frac{1}{4}$ in. from each end. Rivet the two supporting angles to the inside of the tender side sheets as shown, allowing for the thickness of the plate. Then put the plate in place with the tongue at the front through the coal-gate opening, and solder it all round to make it watertight.

The pump is erected in the tank as previously described, but the union elbow is fitted in a $\frac{1}{4}$ in. hole drilled in the soleplate $\frac{5}{8}$ in. ahead of the valve box and $\frac{7}{8}$ in. to the left of the centre line. Connect the two with a swan-neck of $\frac{1}{8}$ in. tube with union nuts and cones at each end.

The tank top and filler are made and fitted in the same way as previously described, the only difference being that this one is only $4\frac{5}{8}$ in. long. The connection between the elbow union and the one on the engine can be made as before, with a $\frac{1}{8}$ in. pipe having two spiral coils in it, or by the alternative shown.

Instead of one coiled pipe, use two short pieces, one with a $\frac{1}{4}$ in. × 40 union coupled to the elbow, and the other with a $\frac{1}{4}$ in. × 26 union to suit the nipple on the engine. Connect the two pieces with a short length of the hose used for cycle-pump connectors. This will stand the pressure required to force the water into the boiler. To prevent it blowing off the copper pipes, fix it with two miniature circlips made from thin brass about 24-gauge, and secured with $\frac{1}{16}$ in. or 10 BA screws and nuts.

Tail-note—I haven't forgotten the grate and ashpan; look out for these in the next instalment!

● *To be continued*

ROSE

LBSC describes the grate, ashpan and final details of the simple locomotive for beginners and offers a few hints on operation

Continued from 12 December 1957, pages 804 to 806

IN fulfilment of promise, here are the details of a suitable grate and ashpan for the coal-fired boiler of this engine, which are easily made and fitted. Similar arrangements have been used on my own engines. The grate and ashpan being assembled as a single component enables it to be replaced after dropping the residue of the fire, without turning the engine upside down. Just push the ashpan up into place, insert the dump pin, and you're all set for lighting up again.

The grate can be an iron casting, or built up. I recommend using a cast grate where available, as it doesn't burn out anywhere near as quickly as a grate made up with cut bars. If our advertisers oblige, they will probably cast the supporting brackets integral with the end bars, and no machining will be required at all. However, don't attempt to rivet the brackets of a cast grate to the sides of the ashpan, or you will be inviting disaster. It doesn't need much of a wallop to knock a bracket off!

Just drill No 41 clearing holes in the sides of the ashpan at the points indicated, temporarily fix the grate in position, and drill the brackets No 48, tapping 3/32 in. or 7 BA and putting screws in place of rivets.

The built-up grate will require five $2\frac{5}{8}$ in. lengths of $\frac{1}{4}$ in. × $\frac{3}{8}$ in. black mild steel strip. The only kind that is more resistant to burning is rustless steel; some years ago I fitted a rustless steel grate to my old veteran *Ayesha* and it shows little signs of burning, although the old girl still does her share of the running on my little railway. Drill a No 41 hole at $\frac{1}{2}$ in. from each end of one of the bars, and use it as a jig to drill the rest.

The four brackets are made from $\frac{1}{16}$ in. × $\frac{1}{4}$ in. steel strip, cut, drilled and bent to the shape shown in the drawing. For the spacers, chuck a piece of $\frac{3}{8}$ in. round mild steel, face, centre, drill No 41 to the full depth of the drill flutes, then part off four $\frac{1}{8}$ in. slices and four $\frac{1}{16}$ in. slices. The bearers are pieces of 3/32 in. steel rod (rustless if available) a full $1\frac{1}{4}$ in. long.

As there won't be room for nuts, the ends of the bearers will have to be riveted over. Burr over one end of each, then assemble bars, brackets and spacers as shown in the plan view, putting the brackets next to the outer bars, and the thin spacers next the brackets. When assembled, rivet over the ends of the bearers so that the whole assembly is perfectly rigid.

ASHPAN

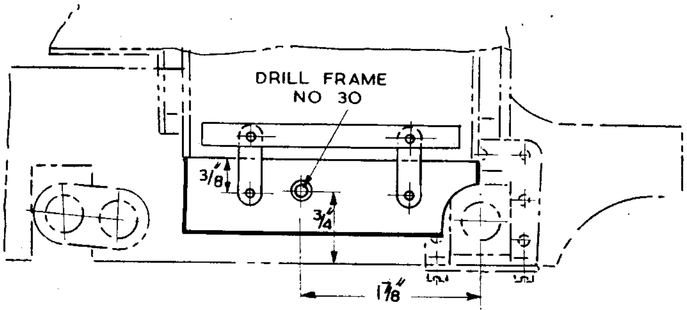
The ashpan is made from 18-gauge or 20-gauge sheet steel, a piece $2\frac{7}{8}$ in. × 3 in. being needed. At $\frac{3}{4}$ in. from each 3 in. side, scribe a line the full length of the piece of metal, then at $\frac{3}{8}$ in. from one of the shorter ends scribe a cross line. Set out the cut-away portion from the intersections, leaving $\frac{1}{4}$ in. full width at each end. Cut out the piece with a metal-cutting fretsaw or a spiral file, then bend the metal to a channel-shape as shown in the cross-section.

The front end is closed, either by brazing in a piece of the same kind of metal, or cutting a piece $1\frac{7}{8}$ in. × $\frac{3}{4}$ in. bending over $\frac{1}{4}$ in. each end to fit between the ashpan sides, and riveting it in place. The $\frac{1}{4}$ in. section above the cut-away is also closed with a piece of strip brazed in, or bent over at each end, fitted between the sides, and riveted. The cut-away part, necessary to clear the trailing axle, is left open.

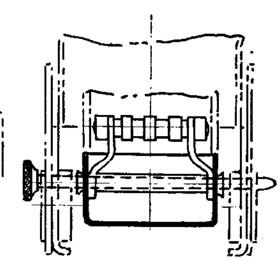
On each side of the ashpan, at $\frac{3}{8}$ in. from the top and $\frac{11}{16}$ in. from the front end, drill a No 41 hole, and another level with it at the same distance from the other end. Set the grate in place and adjust it so that holes in the brackets correspond to those in the ashpan, and fix it with 3/32 in. iron rivets. For jobs like this I keep a piece of 1 in. × $\frac{5}{8}$ in. iron bar handy, grip it in the bench vice with about $2\frac{1}{2}$ in. projecting from one side, put the rivets through from inside the ashpan, slip it over the bar with the rivet head resting on same, and hammer down the rivet shanks in about the same time as it takes me to write the instructions. Beginners tell me that they find these tips handy!

The erection is just the proverbial piece of cake. On each side of the frame, at $\frac{3}{4}$ in. from the bottom and $1\frac{7}{8}$ in. ahead of the trailing axle centre, centrepop and drill a No 30 hole. Stand the engine on the bench with the ashpan in place, jammed up against the bottom of the firebox with a bit of wood—or anything else that may be handy—pushed underneath it. Put the No 30 drill through the holes in the frame and carry on right through the sides of the ashpan.

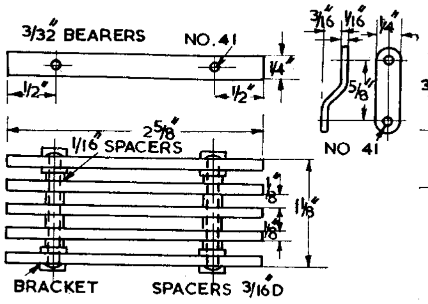
Remove the ashpan and open out the holes with a $\frac{3}{16}$ in. drill. Cut a piece of $\frac{3}{16}$ in. tube to a full $1\frac{1}{2}$ in. length. This must have a hole through



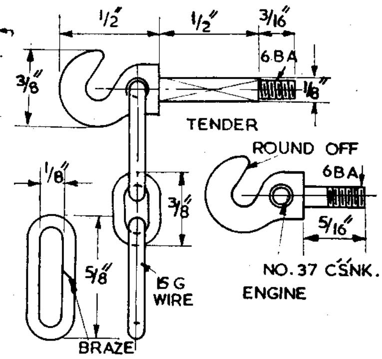
ARRANGEMENT OF GRATE & ASHPAN



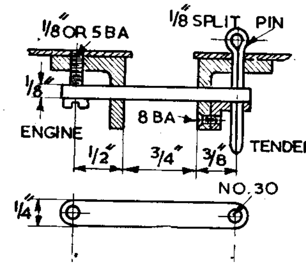
PART SECTION



GRATE



DRAWHOOK & LINKS



ENGINE & TENDER COUPLING

it big enough to allow a $\frac{1}{8}$ in. pin to enter easily. Put the tube through the holes in the ashpan with an equal amount standing out at each side, then bell out the ends by driving a pointed piece of metal such as a big centre-punch into them.

The dumping-pin which supports the whole bag of tricks is just a $2\frac{1}{2}$ in. length of $\frac{1}{8}$ in. round rod with a turned knob screwed on one end, and the other end turned to a blunt point. If the ashpan is pushed up into place and the pin inserted in one of the holes in the frame, the tube guides it to the other hole in a matter of seconds. There is no likelihood of the pin's coming out when the engine is running. When the run is finished, pull out the pin and lift the engine clear—but don't forget to give the grate and ashpan time to cool before you touch it with bare fingers !

TENDER BUFFERS

The tender buffers are a little different from those on the engine. As the frames come right against the buffer holes in the beam, there is no room for a projecting spigot or pin. The sockets are turned from $\frac{5}{8}$ in. round rod, but drill through with No 48 instead of No 41; make the $\frac{1}{4}$ in. × 40 spigot only $\frac{1}{8}$ in. long, and after reversing and opening out with $\frac{5}{16}$ in. drill, tap the remains of the 48 hole 3/32 in. or 7 BA.

Chuck a piece of $\frac{5}{8}$ in. steel rod for the head, face, centre and drill No 41 for $\frac{5}{8}$ in. depth. Turn the stem to a sliding fit in the socket, part off at $\frac{1}{2}$ in. from the end, reverse and turn the head, then open out the hole with 5/32 in. or No 21 drill to a full $\frac{3}{8}$ in. depth.

Chuck a piece of 5/32 in. steel rod, turn $\frac{3}{4}$ in. length to 3/32 in. dia., and screw $\frac{1}{8}$ in. of the end to match the tapped hole in the socket. Part off at about 3/32 in. from shoulder, and cut a screwdriver slot in the head with a fine hacksaw. Push this through the hole in the buffer head, put a 20-gauge steel wire spring on the projecting part, and assemble as shown in the drawing. When the buffer is pressed home into the socket the head slides on the pin, the head of which prevents the buffer head coming out of the socket when the pressure is released.

The end of the hole in the buffer head can be tapped and plugged if desired, but personally I leave the holes open. Some full-size engines have holes in the buffer heads. The spigots are screwed tightly into the tapped holes in the beam. If they are at all slack, put an 8 BA setscrew in the thickness of the beam so that it bears against the spigot, and prevents it from turning.

DRAWBARS AND COUPLINGS

The draw-hooks can be filed up from $\frac{3}{8}$ in. × $\frac{1}{8}$ in. mild steel. After marking out, drill a $\frac{1}{8}$ in. hole in the middle of what will be the hook, and file down to it with a thin flat file. That is the quickest way of cutting the slot correctly. The surplus at top and bottom of the part behind the hook can be cut away with a hacksaw, and the trimming-up with a file is then only a matter of minutes. Don't leave any sharp edges on the hook, take them off with a thin file. Also countersink the hole in the wide part of the hook where the link goes through. Sharp edges are strictly taboo in full size, as they would cut through any link coming in contact with them.

The tender draw-hook has a long square shank, the end of which is filed round and screwed 6 BA. The engine hook has only a short round shank screwed 6 BA at the end, the reason being that there isn't room behind the engine buffer-beam for a long shank. There is barely room for a nut between the lubricator tank and beam, and to fit the hook to the beam it will be necessary to hold the nut with a thin pair of pliers opposite the hole, and screw the shank of the hook into it.

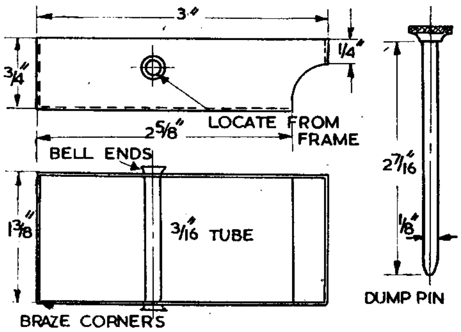
The links are made from 15-gauge steel or nickel-bronze (German silver) wire. They are not difficult to bend up with a small pair of roundnose pliers, but the tricky part is that they must be assembled before final brazing. However, this is only a matter of care and common sense. What I do is to arrange the joints in the middle as shown, and braze the joint in the short link before assembling. The whole lot can then be put together and spread out on a piece of asbestos millboard in the brazing pan.

A little dab of wet flux is put on each joint, and with the little 25-litre tip in my oxy-acetylene blowpipe, I can make each joint hot enough to melt a piece of 1/32 in. brass wire without affecting the rest of the job. If the links are nickel-bronze, silver solder is used. Builders who haven't the same facility can use either the little air-gas blowpipe that I described for silver soldering fittings, or even a mouth blowpipe using methylated spirit will provide enough heat.

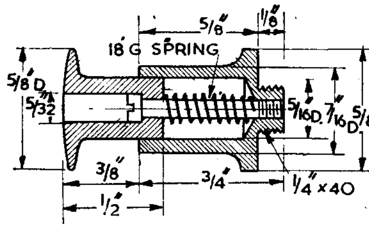
It doesn't matter about heating the whole issue as long as the silver solder or brass wire is only applied to the places where needed. Anybody who is hamfisted can easily get the whole lot rigid—as a popular song of 60 years ago put it: " It's done before you know where you are ! "

The shank of the tender hook should slide freely in the square hole in the buffer-beam, and a spring wound up from steel wire like those in the buffers, is placed over the shank and secured by a 6 BA nut and washer. The engine hook has no spring for reason previously mentioned.

The coupling between engine and tender is just a piece of $\frac{1}{4}$ in. × $\frac{1}{8}$in. steel with two No 30 holes drilled in it at $1\frac{11}{16}$ in. centres. Round off the ends. Opposite the slot in the engine drag-beam, and $\frac{1}{2}$ in. ahead of it, drill a No 40 hole and tap it $\frac{1}{8}$ in. or 5 BA. Turn up a screw to fit from $\frac{1}{4}$ in. steel, leaving $\frac{1}{4}$ in. plain under the head, and attach the drawbar to it by putting the screw in from underneath as shown. The head will just



ASHPAN 18 OR 20 G. STEEL



TENDER BUFFER

clear the bracket carrying the feed union. If the thread is at all slack, slightly burr the end where it comes up through the footplate.

Fit a piece of angle below the slot in the tender beam, as shown in the section. This can be bent up from a piece of 3/32 in. brass or steel ¾ in. long and ⅝ in. wide, between the jaws of the bench vice. The sides are unequal (see drawing) the narrower one being attached to the tender drag beam by two 8 BA screws so that the wider one is level with the bottom of the drawbar slot. Above the centre of the slot and ⅜ in. from the front of the beam, centrepop and drill a No 30 hole through the top of the beam, carrying on right through the angle bracket.

If the slot isn't wide enough to allow the drawbar to slide into it easily, teach it good manners with a flat file. Slightly countersink the holes in the drawbar, and use an ⅛ in. split-pin to connect up. This does the job as well as a turned pin, and if you accidentally drop it in long grass—well, don't waste time, just get another ! Some of my engines have tender toolboxes, and they usually carry two or three spare pins.

That concludes the description of the essential parts of the simple locomotive, but if any builder wants to make her more elaborate, he can easily get a photograph of the GER mixed traffic engine on which I based the design, and add blobs and gadgets to his heart's content. Personally, I liked the appearance of the engines very much, they were nicely proportioned, sturdy and workmanlike withal, and the way in which they could transport a long and crowded excursion train from Liverpool Street, to the East Coast town famous for its bloaters and kippers, left no doubt as to their general efficiency.

As to painting, all I do nowadays is to give the engine a thorough clean with petrol—outdoors, I might add —to remove all oil from the surfaces to be painted, and then apply a coat of some good heat-resisting materials, such as Valspar or Sol. Keep the engine out of a dusty atmosphere while it is drying; a few hours in the domestic airing cupboard will do the trick, provided that the good lady raises no objection !

OPERATION

A few hints on how to run the engine may be useful to the beginner, as even a Rolls Royce car would put up a poor show in the hands of an ignorant driver. The driver of a full-size locomotive never forgets to apply his oil-feeder to every pin joint; follow his good example. Drain any condensate water from the lubricator, and three-parts fill it with cylinder oil of superheater grade. Nature refuses to be "scaled" and steam in the little engine is just as hot as steam in a full-size one, as you'll realise if it meets your flesh ! The lubricator must not be quite full, otherwise no steam can enter and condense, and the lubricator won't function.

In the case of the spirit-fired engine, empty out any cold water in the boiler and half-fill it with hot water; the hotter the better, as steam will be raised with less consumption of spirit in less time. Take off the smokebox front, to give the burners plenty of ventilation.

Screw down the spirit valve on the tender, three-parts fill the tank with methylated spirit, see that the filler is screwed down airtight, and that the wicks (which should be made up with asbestos string or yarn) are loose in the wick tubes and project from the top in a small bunch. If the wicks are packed too tightly the flame will die down. Connect the feed tube on the sump to the one on the engine with a piece of rubber pipe, and see that there is no kink in it, when the engine is coupled to the tender.

Open the spirit valve fully. Spirit will then flow to the sump until it covers the opening of the air pipe; then, as no more air can enter the tank, it will cease to flow. A taper is handiest for lighting the burners. Steam will be up in a very few minutes; if the blower valve is left open a little, you will hear it blow up the chimney liner. The smokebox front may then be put on. Fill the water tank in the tender—again, hot water is a spirit-saver—and the engine is ready for a run.

Leave the blower on a little, or flames will come from under the firebox when the regulator is shut. Wait until the safety-valve starts blowing off, then open the regulator a little and assist the engine by hand for the first few turns of the wheels, while the cylinder warms up and clears itself of water.

As soon as the exhaust steam comes out dry with sharp and snappy beats, the engine is all right for service. She will pull a dozen coaches, or a load of wagons, or an adult passenger if the flat car has ball-bearings and runs easily. The power that can be obtained from that one cylinder supplied with plenty of really hot steam, is surprising to the uninitiated. The secret is that with the valve setting as specified—lead, early cut-off, and above all free exhaust—the cylinder *uses* the steam instead of *wasting* it.

When running with a train, stop the engine when the water gets low in the glass, and pump more in until it is half-full again. If riding, keep the water about half-way up the glass by an occasional three or four strokes of the pump as required. A high level isn't needed, as steam production depends on maintenance of boiler temperature, and the burners can keep a half-full boiler hotter than a full one. Warning: never unscrew the spirit filling-plug without first closing the spirit valve, or there will be a fire, caused by the sump and burners flooding as soon as air is allowed to enter the tank.

The locomotive with a coal-fired boiler is oiled up and prepared in the same way as described, but there is no need to empty out the boiler. Just see that the water is about three-parts up the glass. Connect a tyre-pump to the feed-pipe union under the drag beam. See that the tender has a supply

Continued on page 30

POSTBAG . . .

ridiculous to use pressures of the order of 150 p.s.i.? I use it so that the machinery may function in much the same manner as on the prototype; it is certainly much more realistic than the pressures of over 100 years ago. To suggest that the higher pressure is unnecessary is surely quite a silly remark. Of course it is not necessary, neither is it necessary to build the locomotive at all.

We who build scale model locomotives do it for our own pleasure, and surely it is reasonable that we be allowed to do this in our own way without being called ridiculous. It would be a very dull world if everyone were content to work to rules laid down by someone else.

Bexhill, Sussex. C. M. KEILLER.

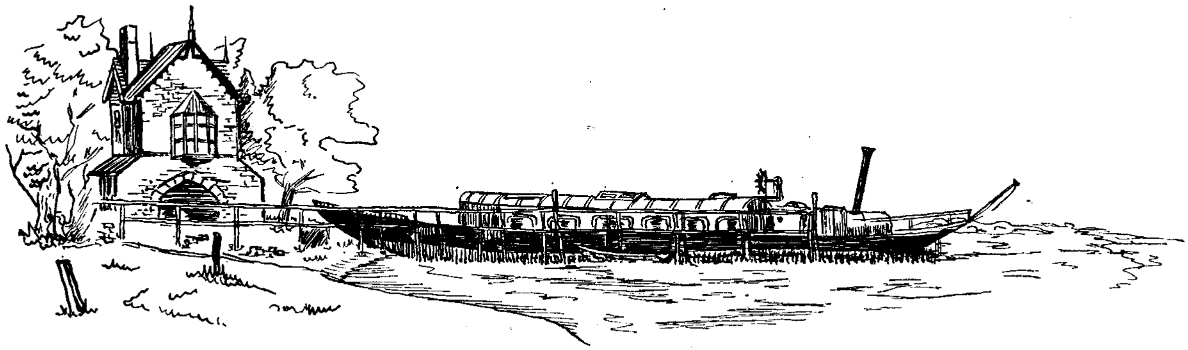
CONISTON STEAMER

SIR,—The tracing of the Coniston lake steamer *Gondola* shows her alongside the Waterhead Pier. The foremast and mainmast have been removed and the position of the steering wheel has been altered.

Originally the winding drum was forward of the wheel which was mounted on the fore end of the boiler casing, which is lower than the saloon roof. Judging from the tracing a platform carrying the steering gear appears to have been built between the aft end of the saloon and the fore end of the boiler casing. These alterations were made by the LMS.

My impression is that the model of the *Gondola* at the Railwaymens' Club at Barrow is one which was made by Capt. Hammel, who spent most of his life in charge of this ship, and that it was made just before or during the early part of the first world war. I used to meet the old captain on the branch train and I remember his talking about it.

Glasscroft, R. C. ROBERTS.
near Oldham.



The Coniston Lake steamer GONDOLA *moored at Waterhead Pier*

SIR,—The steam *Gondola*, as I believe it was referred to, worked on Coniston Water, and was built (or engined) to Ramsden's patent, according to a fairly good but dust covered model of her in the Railwaymens' Club, at Barrow. The latter is, as you probably know, the old FR Barrow station in Ramsden Square, bequeathed, on a no-rental basis, to railwaymen as a licensed club by Ramsden himself upon retirement.

The Greenodd signalman gave me an old sepia print 7 in. $\times$ 5 in., unfortunately stuck with its face onto a sheet of glass, of the *Gondola*, shown at moorings. I enclose a tracing of this. It is fairly sharp (how different from modern photographs!) and would be quite useful for a model of her.

Kingswood, P. D. BEDDOE.
Bristol.

Mr Beddoe's letter was passed to Mr Roberts before publication.—EDITOR.

CUP WINNERS' STAND?

SIR,—I would like to say how much I like the ME although I am not in a position to be an active model engineer at the moment. The ME Exhibition has always been a must for me, and is always marked off in my appointment book, but I would like to make a suggestion for what it is worth.

Would it be possible to arrange a special stand every year to see *all* the past championship cup winners? For example, I did not see Mr Powell's $7\frac{1}{4}$ in. Duchess, or Mr Gerald Smith's 18-cylinder radial engine.

Finchley, COLIN ANDREWS.
London N3.

KNOW-HOW NEEDED

SIR,—I often wonder why someone doesn't explain the height gauge face-plate and angle-plate method of setting out. To me this is more essential to small model making than a lathe.

It is also, to my mind, far easier to work in decimals. Why must we have to convert from fractions all the time?

Most commercial firms on precision work stick to fractions for limits down to 0.015 in.; for limits of 0.005 in. they use decimals.

Third angle projection is also much easier, too.

Lacock, Wilts. BRIAN M. GATLEY.

ROSE . . . *continued from page 20*

of coal broken up to pea size and with the dust sifted out. A mixture of Welsh steam coal and anthracite will give best results. Coalite can be used, but it burns away at a terrible rate. Don't use ordinary house coal, which will choke the tubes with tar and soot.

Cover the firebars with charcoal wetted with paraffin, open the blower valve, throw in a lighted match and start pumping. The air pumped in will work the blower jet and create plenty of draught, and the fire will roar. Feed in more charcoal until steam is up, about three minutes, then as soon as there is enough pressure to operate the blower, disconnect the tyre pump, couple up the water pipe, and put some coal on.

When the safety-valve lifts, help her to start, as with the spirit-fired version. When running, keep the water about three-parts up the glass, as the firebox crown must be well covered. The fire should be kept just below the door. Fire little and often; don't let it die down and then smother what is left, or you've had it! The best time to fire is when she starts blowing off, as the heat of the incandescent fire, instead of making steam to blow to waste, is utilised to light up the fresh coal.

A little practice will soon produce an efficient engineman. ■